



**Department of Energy**  
Richland Operations Office  
P.O. Box 550  
Richland, Washington 99352

03-ESD-0012

**NOV 20 2002**

Mr. E. K. Thomson, President  
Fluor Hanford, Inc.  
Richland, Washington 99352

Dear Mr. Thomson:

**CONTRACT NO. DE-AC06-96RL13200 – REPORT ON THE ASSESSMENT OF FHI FIRE PROTECTION PROGRAM (FPP)**

During June and July 2002, the RL Engineering Support Division performed an assessment of the FHI FPP to validate the effective implementation of the FHI FPP by examining implementation at key FHI projects. The final report is attached.

The assessment determined a number of positive outcomes, as well as issues that require the attention of the contractor. The most significant deficiencies were identified in the areas of fire hazard analysis and compensatory measures. Many of the deficiencies in these areas were related to the apparent lack of integration between the FHA and the Authorization Basis (AB).

Please provide a Corrective Action Plan for each finding in the assessment report to Shirley J. Olinger, Assistant Manager for Safety and Engineering, within 45 days from the date of this letter, and a copy to Lee J. Voigt, ATLII, for tracking purposes. Additionally, FHI should include in their response a description of actions taken to address each of the Observations and Opportunities for Improvement appearing in the report.

If you have any questions please contact me, or your staff may contact, Craig Christenson, Engineering Support Division, on (509) 376-5367.

Sincerely,

A handwritten signature in black ink, reading "Michael H. Schlender", is positioned above the printed name and title.

Michael H. Schlender  
Deputy Manager

ESD:CPC

Attachment

cc w/attach:  
M. W. Frei, EM-40  
D. E. Good, FHI  
S. L. Johnson, EM-5  
R. E. Jordan, FHI  
M. T. Sautman, DNFSB

# **Report on the Assessment of Fluor Hanford, Inc. Fire Protection Program**



***Department of Energy  
Richland Operations Office***

**ESD-CPC-02-001**

**NOVEMBER 16, 2002**

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## ACRONYMS

AB	Authorization Basis
AC	Administrative Control
AMU	Aqueous Makeup Unit
ARM	Area Radiation Monitor
BEP	Building Emergency Plan
CAM	Continuous Air Monitors
CEDE	Cumulative Effective Dose Equivalent
CFR	Code of Federal Regulation
CRD	Contract Requirements Document
CRAD	Criteria Review and Approach Document
CSB	Canister Storage Building
CVDF	Cold Vacuum Drying Facility
CWC	Central Waste Complex
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
EDE	Effective Dose Equivalent
ESD	Engineering Support Division
FHA	fire hazard analysis
FHI	Fluor Hanford, Inc.
FSAR	Final Safety Analysis Report
FST&M	Fire System Testing and Maintenance
gpm	gallons per minute
GS	General Service
HEPA	High Efficiency Particulate Air
HFD	Hanford Fire Department
HGET	Hanford General Employee Training
HSO	Hanford Site Operations
INEEL	Idaho National Environmental Engineering Laboratory
ISB	Interim Safety Basis
ISMS	Integrated Safety Management System
ITS	Important to Safety
IT&M	Inspection Testing and Maintenance
JCO	Justification for Continued Operation
M&O	Managing and Operating
MCO	Multicanister Overpack
MPFL	maximum possible fire loss
MCFL	maximum credible fire loss
NFPA	National Fire Protection Association
ORP	Office of River Protection
OSR	Operational Safety Requirement
PHMC	Project Hanford Management Contract
PISA	Potential Inadequacy in Safety Analysis
psi	pounds per square inch
RCP	River Corridor Project

RL	DOE, Richland Operations Office
RLID	RL Implementing Directive
SAR	Safety Analysis Report
SB	Safety Basis
SC	Safety Class
SEL	Safety Equipment List
SERF	Special Environmental Radiometallurgy Facility
SNF	Spent Nuclear Fuel
SOP	Step Off Pad
SS	Safety Significant
SSC	Structures, Systems, and Components
TRU	Transuranic
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question
WESF	Waste Encapsulation and Storage Facility
WMP	Waste Management Program
WRAP	Waste Receiving and Processing Facility

## EXECUTIVE SUMMARY

U.S. Department of Energy (DOE) Order 420.1, *Facility Safety*, Section 4.2.1 requires that DOE and the contractor implement and maintain an acceptable Fire Protection Program, which includes fire protection program assessments. Fire protection assessments are documented evaluations of the Fire Protection Program, including field walk downs of facilities. Accordingly, a review of the FH Program was conducted during June and July 2002.

This fire protection assessment evaluated compliance with DOE Richland Operations Office (RL) Implementing Directive 420.1, *Fire Protection* and DOE Order 420.1, which were in the FHI contract at the time of the assessment. The assessment also focused on the core fire protection elements in the Contract Requirements Document (CRD) 420.1 supplemental, *Facility Safety*, as the supplemental CRD was forwarded by RL letter 02-PRO-0817<sup>1</sup>, stating RL's intent to include the CRD 420.1 supplemental directive into FHI's contract and cancel RL Implementing Directive 420.1.

The fire protection assessment utilized a graded approach to address each Criteria Review and Approach Document area contained in the *Implementation Plan for the Assessment of the Fluor Hanford, Inc. Fire Protection Program*, dated May 30, 2002. The assessment also focused on Fire Protection Program implementation in an array of key FHI facilities as well as the effectiveness of the FHI management self-assessments to obtain an overall evaluation of program implementation effectiveness.

Overall assessment results, detailed results, and overall issues are presented in the Assessment Results, Detailed Results, and Findings and Observations sections of this report.

The Assessment Team performed detailed and critical reviews in all areas addressed within the assessment implementation plan to address the following fire protection Criteria Review and Approach Documents (CRAD) and provides general results of each:

CRAD	Met	Partially Met	Not Met
Fire Protection Program	X		
Self-Assessments		X	
Fire Protection Engineering	X		
Fire Prevention		X	
Fire Safety Training	X		
Fire Hazard Analyses			X
Protection of Safety Equipment, Mission, Property, and Environment			X
Life Safety Considerations	X		
Fire System Operability	X		
Administrative Controls and Compensatory Measures		X	

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<sup>1</sup> Hopko, A.E., 2002, *Supplemented Contractor Requirements Document (CRD) DOE O 420.1 Chg. 3 (Revision 0)*, *Facility Safety* (letter 02-PRO-0817 to E.K. Thomson, Fluor Hanford, Inc., dated May 7), Richland, Washington.

The fire department emergency elements contained in DOE Guide 420.1, *DOE Implementation Guide for Use with DOE O 420.1 and DOE O 440.1, Fire Safety Program* were not included in this assessment due to 1) having recently been evaluated by the DOE Office of Environment, Safety, and Health Oversight during the Hanford Site Comprehensive Fire Safety Review in August 2001, and 2) FHI revised its fire department baseline needs assessment in the *Hanford Site Emergency Response Needs*, Revision 1 document in June 2002.

The Assessment Team determined there were several positive conclusions and some shortcomings related to the FHI Fire Protection Program. Most deficiencies were identified in the areas of fire hazard analysis (FHA); protection of safety equipment, mission, property, and environment; administrative controls and compensatory measures; fire prevention; and self-assessment. Many of the deficiencies in these areas were related to the lack of integration between the FHA and the Authorization Basis (AB).

### FIRE HAZARD ANALYSIS

The Assessment Team focused a significant portion of the assessment on the FHA objective area to determine if the contractor had implemented an appropriate fire hazard analysis program, which includes a process to update facility fire hazard analyses, that the analyses reflect facility fire hazards, and the analyses are consistent with Authorization Basis safety documents in the area of fire. During this review, the team determined that the FHA CRAD was not met mainly because facility-documented safety analyses and fire hazards analyses are not fully integrated, and fire hazard analyses in the FHA were out of date and implementation needs improvement. The contractor was notified of these findings and results of each are discussed within the individual facility write-up. Although there were numerous findings from the review, in the opinion of the review team, none were significant enough to suggest that the fire protection program was inadequate for protection of Hanford facilities.

Generally, the FHAs postulate a greater number of fire scenarios than those considered in the Authorization Basis safety documentation. This is partially the result of the FHA and Authorization Basis requirements documents specifying different assumptions, and the focus of these analyses being different, and the fact that they were written by different parties during different time periods. Also, usually the FHAs consider more than just bounding scenarios as sometimes found in the AB. This does not necessarily suggest the FHAs are more conservative than the AB, only that they are more detailed and complete. As a result, many times scenarios identified in the FHAs do not appear to be analyzed in the AB. Improved coordinated integration is needed between these two documents relative to fire hazards, and where there are differences, the documents should address the differences and justify the reasons.

FHI has already recognized this deficiency and has taken various steps to identify these weaknesses, making off-normal occurrence notifications to DOE of several potential inadequacies in safety analyses (PISA). Furthermore, the contractor is taking various actions to address these disconnects by performing Unreviewed Safety Question (USQ) determinations and Justifications for Continued Operations (JCO) where the USQ was determined to be positive. Additionally, the effort to become rule compliant (10 CFR 830) by April 2003 will help to resolve these discrepancies.

Additional concerns related to the FHA determined that controls, conditions and assumptions of fire hazard analyses documents do not always flow down into facility controls. This condition was noted in the 222-S Analytical Laboratory FHA where the fire analysis states that the types and quantities of combustible materials found during a facility tour are representative of the potential fire hazards in the lab and that a greater combustible inventory could affect the analyzed fires. However, no formal combustible control procedure or program (other than for flammable liquids under National Fire Protection Association [NFPA] 45) exists for the 222-S Analytical Laboratory to ensure that the fires analyzed by the FHA will not be exceeded by additional inventory into the lab. This is not a nuclear safety issue in that the 222-S Laboratory Safety Analysis assumes complete destruction of the facility by fire within the administrative controlled source term limits and the resulting dose is within acceptance guidelines (i.e. AB is more conservative than the FHA). In addition, combustible loading limits defined by the 242-A Evaporator FHA (Section 6.4.1) have not been incorporated into facility-specific procedures to ensure that limits will not be exceeded. The 242-A Evaporator has declared a PISA and a positive USQ, and a developed a Justification for Continued Operation (JCO) which was approved by DOE-RL on August 09, 2002.

Due to the changing operations and activities, the fire hazards analyses also do not always capture the current fire hazards that may present inadequacies in the safety analyses. For example, the fire hazards analysis for the Canister Storage Building (CSB) evaluates several scenarios in the operational area and provides a basis for establishing combustible controls. However, a hydraulic fluid fire (pressurized-spray fire) was not considered in the Canister Storage Building FHA for the MCO Handling Machine (MHM) which contains over 50 gallons of combustible hydraulic fluid, and may pose a significant hazard to safety-class equipment in the CSB. The Canister Storage Building declared a PISA on November 14, 2002, and is in the process of evaluating this concern.

In another case, the FHA for the 327 Facility evaluated most of the significant hazards in the facility and provides conservative conclusions. However, the 327 FHA did not fully address fire scenarios in the basement, particularly the "Class A" fuel packages that were observed during the assessment that could expose the unprotected structural steel. The FHA evaluated only a large ventilation-limited hydraulic fluid fire in the basement and concluded that structural failure is not likely. This FHA concluded that this fire would bound all others, although a smaller "Class A" fuel package or possibly a pressurized-spray fire could damage the steel (not ventilation limited where critical temperatures could be reached) and cause structural failures and openings to develop in the floor. This is of particular concern because the same fire could also cause a radiological contamination release from the high efficiency particulate air (HEPA) filters. As a result of this assessment, the facility removed a considerable amount of combustible materials from the basement to address this concern. However, formal controls to maintain combustibles at a safe level were not in place and the fire hazard analysis did not analyze for "Class A" combustibles that were stored in the basement at the time of the assessment. Subsequently the 327 Facility declared a PISA on November 8, 2002, and is in the process of evaluating the concern.

The FHA for T Plant focused on fire scenarios in the canyon area and provided recommendations for limiting fire growth in this area. Scenarios were also evaluated in the 271-T Building office areas and the building has since implemented the controls and the

configuration in the canyon area is markedly improved. However, there was a significant accumulation of combustible materials in other areas that were not considered in the FHA, notably the pipe and electrical galleries where palletized storage was noted during the Assessment Team facility tours. There is the potential for a post-flashover fire in these areas that could compromise the rating of the fire doors and possible spread to other areas. There are no combustible controls enforced in these spaces. This is not a nuclear safety concern because it does not affect the radiological source of the facility. However, T Plant is addressing the issue under life safety code of NFPA.

The FHA for the 105-KE Basin captures the most severe hazards, but should be expanded to consider large “Class A” combustible fuel packages in and around the Transfer Bay Area. This is predicated from the current presence of scaffolding, wood crates, and a canister cleaner structure with polymer windows in the Transfer Bay Area. These items may be staged near unprotected structural steel and/or safety class equipment, and there is also no direct control on the maximum quantity of these materials, indicating that accumulations could exceed the fire scenario fuel load assumed in the FHA in this area. While FHI procedures allow flame resistant treated wood to be used in these facilities, flame resistant treated wood is still a combustible material that should be analyzed and controlled in facility usage. Another FHA deficiency is that 105-KE Basin does not address indirect fire and smoke hazards from wildfire as required by the *Initial Joint Review of Wildland Fire Safety At DOE Sites*<sup>2</sup>. Lastly, there are several long-standing recommendations (prior to 2000) that have not been tracked in the Corrective Action Management system or corrected.

#### PROTECTION OF SAFETY EQUIPMENT, MISSION, PROPERTY, AND ENVIRONMENT

In the protection of safety equipment, mission, property, and environment objective area the Assessment Team discovered some additional deficiencies in the FHAs significant enough to conclude that the criteria for this area was not met. Fire protection requirements for safety class systems are not always specifically mentioned in the FHA as required by DOE. Additionally, in some cases Authorization Basis document updates were made that added safety-class equipment that were not updated in the FHA and fire impacts to safety-class systems were not always considered in sufficient depth in FHA and Authorization Basis documents.

The review team also determined there were some facilities that do not meet DOE requirements for loss limitations because FHA recommendations remain open and inconsistencies between hose-stream requirements contained in the prefire plan verses the FHA exist. Improved coordinated integration is needed between the prefire plan and the FHAs relative to hose-stream requirements and where there are differences, the documents should address the differences and note the reasons. Disparities in the hose-stream requirements creates confusion as to what the actual hose-stream demand is, and whether or not the water supply is capable of supplying the hose-stream demands.

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<sup>2</sup> O'Brien, J. and D. Kubicki, 2002, *Initial Joint Review of Wildland Fire Safety at DOE Sites*, U.S. Department of Energy-Headquarters, Office of Independent Oversight and Performance Assessment, Washington, D.C.

## ADMINISTRATIVE CONTROLS AND COMPENSATORY MEASURES

The Assessment Team evaluated the contractor's methods to maintain an appropriate method of establishing, identifying, tracking, and maintaining administrative controls and compensatory measures. The team concluded that the main administrative controls and compensatory measures objective was not fully met because the facilities do not have a central means of tracking, initiating, cross-referencing, or managing administrative controls and compensatory measures.

There are implicit (and to a lesser extent, explicit) controls also described in the FHA documents that are not implemented in facilities. In some cases, exemptions and equivalencies are based on implied and/or explicit FHA controls. Because these controls are not always implemented at the facility level, there is a potential for exemption and equivalencies to be violated. These controls may impact operational safety requirements for the facility and may impact fire safety equivalencies and exemptions. Implicit controls are directly related to the accident and fire scenario assumptions in the FHA and Authorization Basis documents and are difficult to capture. However, these assumptions may include the combustible load, configuration, facility makeup, and ventilation conditions. This disconnect may arise because the FHA evaluations tend to focus on the most severe hazard that currently exists in a facility rather than attempting to determine the most severe condition that the facility can tolerate (i.e., a limiting scenario).

There is no process to ensure critical assumptions related to FHA/AB exemptions/equivalencies relative to fire protection controls are maintained. In addition, there is no centralized means of initiating, tracking, cross-referencing, and managing administrative controls at the building level. Furthermore, there is the potential for combustible and fire conditions to exceed levels analyzed in the Authorization Basis and FHA documentation.

In analyzing combustible controls at FHI high-risk facilities, RL and FHI continue to identify deficiencies and improve alignment between the FHAs and AB. Recent AB updates, the USQ evaluation process and the declaration of PISAs, subsequent positive USQs, and deliberate compensatory measures through the JCO process over the last two years have resulted in much improved combustible controls at these facilities. Examples include PFP, WRAP, CWC, WESF, and 242-A. Also, prior to operation in December 2000, the Spent Nuclear Fuel Project established explicit conservative controls consistent with the FHA and AB. As a result of this report, PISAs were declared at 242-A, 327, and CSB. As part of the corrective actions associated with the 2001 Office of Environment, Safety, and Health Comprehensive Fire Safety Review of the Hanford Site Report, FHI currently is assessing the adequacy of the combustible controls for all Category 2 and 3 nuclear facilities. Results of this FHI assessment are expected sometime in November 2002.

## FIRE PREVENTION

Another important element evaluated was fire prevention. The purpose of the fire prevention objective area was to determine if the contractor had implemented an appropriate fire prevention program that included periodic fire prevention inspections; procedures or methods for controlling combustible, flammable, radioactive or hazardous materials to minimize the risk from fire; procedures or methods for limiting smoking as an ignition source; and ensuring hot work

controls and procedures are in place. Overall, the team determined that this criterion was not fully met. Periodic fire prevention inspections are being performed, FHI is maintaining appropriate vegetation control around its facilities, ignition sources are limited, and hot work controls are in place. However, there was one major deficiency in the fire prevention area noted with regard to the lack of a robust combustible control/housekeeping control and implementation. It is a concern to DOE where heavy reliance on a robust combustible and ignition source control is credited in the authorization basis, and yet this assessment found problems with the lack of rigor in procedures and or poor implementation of controls.

Specifically, discrete housekeeping and combustible controls were generally too vague or nonexistent in a number of FHI facilities. In addition, procedures that require facilities to "minimize combustibles" are not effective since there could be more combustibles in the facility than analyzed in the FHA or Authorization Basis Document. This also was noted in the October 2001 Office of Environment, Safety, and Health Comprehensive Fire Safety Review of the Hanford Site Report, page 12, where it was concluded that "the established program to control excessive accumulations of combustible materials and possible ignition sources within the Plutonium Finishing Plant is not fully effective".

Examples of poor housekeeping and lack of controls observed during the facility tours included staged-waste accumulation awaiting removal from facility decommissioning and demolition in the 327 Building hot cell area, wood scaffolding accumulation in the 105-KE Basin, and the storage of palletized combustible materials in T Plant pipe and electrical gallery. While these items in themselves do not necessarily represent a specific facility fire-safety issue, the question of "how much combustible material becomes too much combustible material" is presented where the areas and material hazards utilized have not been analyzed and controlled.

The Assessment Team did observe discrete combustible controls implemented for the 324 and 327 hot cells, in the Waste Encapsulation Storage Facility, and in the operational area of the Canister Storage Building. Additionally, the 222-S Analytical Laboratory housekeeping was excellent, and while there were written controls for flammable liquids, other controls to maintain the housekeeping at an acceptable level was not specifically written for the laboratory.

### SELF-ASSESSMENTS

The Assessment Team evaluated FHI self-assessments in the fire protection area by reviewing fire protection facility assessments, procedures, letters, and conducting interviews. While most fire protection facility assessments are being performed by qualified fire protection engineers that meet DOE expectations, and Facility Evaluation Board Assessments are conducted that include fire protection elements specific to facilities, the fact that the fire-protection program assessment has not been conducted since 1998 resulted in the self-assessment criteria area not being fully met. While other related fire assessments have been completed, a number of program elements such as adequacy of facility fire protection assessment reports, administrative controls, temporary protection, and compensatory measures are not being assessed anywhere within FHI as required by DOE. The review in this area also determined that administrative controls contained in facility FHAs do not appear to be adequately addressed in facility fire-protection assessments. Finally, the 105-KE and 105-KW Basin fire protection facility assessment is overdue.

## FIRE PROTECTION PROGRAM

The review of the criteria identified that the Fire Protection Program is well documented with assigned roles and responsibilities that are well defined and known within the company. FHI places a high priority on fire safety with focus through the Hanford Fire Marshal's Office, the Hanford Fire Department, and Fire Systems Testing and Maintenance to meet DOE fire safety objectives. This area did identify two weaknesses; deficiencies and recommendations identified by fire hazard analyses are not always tracked or corrected, and concerns exist regarding the lack of facility administrative controls necessary to maintain the assumptions and conditions of approved fire safety exemptions and equivalencies. In addition, the current method for granting deviations or variances to FHI processes and procedures raises questions regarding the limits of authority of the Fire Marshal, as opposed to RL, in allowing modifications to application of national codes and standards. A clearer limit of authority needs to be included in contractor procedures.

## FIRE PROTECTION ENGINEERING

A critical part of the Fire Protection Program is the fire protection engineering necessary to ensure that important requirements and features for safe operation are being incorporated into the design of contractor facilities. The Assessment Team determined that the Fire Protection Engineering program is adequate. FHI fire protection engineers meet the definition of “qualified” as delineated in DOE requirements and engineering personnel have the requisite knowledge to perform assigned job duties necessary for the review criteria to be met. However, some shortcomings in this area were noted; the training and qualifications of the site fire protection engineers does not provide for in-house performance of analytical evaluations such as fire modeling or assessment of hazardous conditions via calculations, and professional development training for Fire Protection Engineer professionals is limited and restricts the capabilities available to the Hanford Site in general.

## FIRE SAFETY TRAINING

The Assessment Team evaluated the fire safety training objective area to determine if fire safety training is provided to all employees and that the training is appropriate to meet DOE expectations. The team concluded that the fire safety training criteria, review and approach elements objective was met. Fire safety training is provided to all employees through Hanford General Employee Training. Additionally, employees who perform fire watches also receive hands-on portable fire extinguisher training in accordance with Occupational Safety and Health Act requirements.

## LIFE SAFETY CONSIDERATIONS

Facility life safety was evaluated by the team under the life safety objective area. The purpose of this area was to determine if FHI's program had implemented effective life safety practices, including basic and specialized life safety provisions that are incorporated into designs and operational facilities consistent with NFPA 101, *Life Safety Code*.

Overall, the Assessment Team concluded that life safety provisions are generally maintained in existing facilities necessary to meet the objectives of this area. NFPA 101 requirements are

implemented into facility designs. A minimum of two paths of protected egress out of facilities was generally observed, travel distances appear adequate, and exit signs at the appropriate places were provided. Unique fire protection features of the life safety code, such as sprinkler protection and emergency fire alarm systems, were also provided in most facilities.

One deficiency was noted concerning the adequacy of emergency lights. While emergency lighting units appear to be individually tested, lighting system performance throughout the required areas does not appear to be adequate in a number of facilities observed (e.g., T Plant, 105-KW Basin Transfer Bay, 324). A qualitative test in many of these windowless structures might be prudent to ensure employee safety during a fire or electrical outage. Although procedures are in place to perform preventive maintenance and operational checks of emergency lighting units, this does not include an assessment of the adequacy of lighting levels. A similar issue was identified at another DOE site, which resulted in the discovery of inadequate illumination (see Occurrence Report, ORO-MMES-Y12DEFPGM-1993-0093, *Defective Emergency Lighting*).

### FIRE SYSTEM OPERABILITY

The Assessment Team also focused on the effectiveness of FHI's inspection, testing, and maintenance program and an impairment system for fire protection systems and equipment through the Fire System Operability area criteria. Overall, the inspection, testing, and maintenance program for fire protection and life safety systems for FHI is acceptable to conclude that the criteria, review and approach elements of this area were met.

Fire protection systems are being professionally inspected, tested, and maintained in accordance with NFPA standards and DOE expectations. The Hanford Fire Department Fire System Testing and Maintenance Organizations have qualified personnel to address the fire protection systems. In addition, FHI facilities are inspecting and testing non-system fire protection features (e.g., fire doors, fire barriers, exit signs, etc.).

One area of deficiency identified in the Fire System Operability area was related to the control and long-term planning of the water supply that supports the fire-protection sprinkler systems in a number of facilities. The Water Supply System Master Plan did not address long-term issues for fire protection. While the Master Plan addressed site-wide water demands, it did not address specific needs for fire-suppression systems that are important to safety. Furthermore, the Master Plan did not integrate fire protection systems needs and vulnerabilities in the weighted priority replacement matrix for underground piping consistent with facility missions and future needs of these important fire safety systems.

FHI also does not have structured programs to interface the water utilities group with fire protection system owners and facilities to ensure continued service of systems. Additionally, water supply component impairments supporting fire systems are not controlled with the same formality as internal fire protection systems.

An issue regarding the lack of obstruction investigations in sprinkler piping was also found in the Fire System Operability area. Essentially, internal sprinkler piping obstruction investigations per NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, are not being performed and fire sprinkler piping could be blocked. While

the NFPA standard is subjective as to whether or not obstruction investigations should be performed, no technical baseline study is present to justify the lack of doing this investigation in facility systems. Based in this assessment, FHI began inspections to collect baseline data, and identified debris and plugging in a number of dry pipe sprinkler systems within the Central Waste Complex (CWC). FHI continues to take appropriate compensatory measures to work through the fire protection and authorization basis issues as they arise.

Although the FHI Fire Protection Program in general meets or exceeds many of the criteria, the lack of integration between the FHAs and AB documents continues to cause problems with the implementation of administrative controls. FHI currently is assessing the adequacy of the combustible controls for all Category 2 and 3 nuclear facilities. Results of this FHI assessment are expected sometime in November 2002. Additionally, FHI's efforts to become rule compliant (10 CFR 830) by April 2003 also will resolve these discrepancies

A written Corrective Action Plan is required for each of the identified Findings. Additionally, FHI should include in their response a description of actions taken to address each of the Observations appearing in the report.

## FINDINGS AND OBSERVATIONS

### TERMINOLOGY

**Finding:** An individual item, which does not meet requirement. The requirements basis for Findings can range from laws to facility level procedures.

**Observation:** A condition or practice that does not provide or promote effective protection of the health and safety of the public, workers, or the environment, but is not directly linked to compliance.

**Recommendations:** Suggestions offered by the U.S. Department of Energy, Richland Operations Office that may assist contractor line management in identifying options and potential solutions to various issues identified during the conduct of the assessment.

**Good Practices:** Activity or item identified that is particularly noteworthy. The contractor

### SUMMARY OF FINDINGS AND OBSERVATIONS

This section provides a brief summary of findings (F), observations (O), and good practices. For explicit requirements and examples developed by the Assessment Team to support these items see the Assessment Results and Detailed Results sections of this report.

### FINDINGS

- F-01** Documented safety analyses and FHAs are not fully integrated as required by DOE Orders.
- F-02** FHAs are not current and implementation requirements need improvement.
- F-03** Housekeeping and combustible controls requirements are often too vague or nonexistent in facility procedures, yet a robust program is credited in the Authorization Bases.
- F-04** There is no process to ensure critical assumptions in FHA/AB, exemptions, and equivalencies relative to fire protection controls are maintained.
- F-05** Fire protection self-assessments are out of date with at least one not being conducted since 1998.
- F-06** Fire safety-related exemptions and equivalencies are not always controlled and need rigorous attention and controls.
- F-07** Emergency lighting is inadequate in a number of facilities.

### OBSERVATIONS

- O-01** Internal sprinkler piping obstruction investigation baseline study is needed across the site before concluding that the obstruction investigation per NFPA 25 is not required.
- O-02** Water supplies for fire protection systems are not controlled with the same formality as internal fire systems.
- O-03** The master plan for site-wide water system does not address future fire water demands, priorities, and vulnerabilities for fire suppression systems that are important to safety.

### GOOD PRACTICES

- GP-01** The overall written FHI Fire Protection Program is well documented, meeting DOE expectations.
- GP-02** Overall life safety features are satisfactory in FHI facilities observed.
- GP-03** FHI is maintaining vegetation control around its facilities.
- GP-04** FHI uses the hot work procedure based on the Fire Marshal permit system. The procedure is based on NFPA and DOE requirements.
- GP-05** Fire protection systems are being professionally inspected, tested, and maintained in accordance with NFPA standards and DOE expectations.
- GP-06** The Fire Systems Testing and Maintenance Organization has qualified personnel to address the fire protection systems.
- GP-07** Facilities are inspecting and testing non-system fire protection features (e.g., fire doors, fire barriers, etc.).

## INTRODUCTION

U.S. Department of Energy (DOE) Order 420.1, *Facility Safety*, Section 4.2.1 requires DOE and the contractor to implement and maintain an acceptable Fire Protection Program, which includes program assessments. The DOE Richland Operations Office (RL) Integrated Management System *Fire Protection Program Description* states that RL addresses the Fire Protection Program objectives by a number of methods including, but not limited to, RL Engineering Support Division (ESD) assessments. Fire protection assessments are documented evaluations of the Fire Protection Program, including field walk downs of facilities.

The RL ESD, supported by other program and staff, are required by the *Fire Protection Program Description* to perform program assessments of each prime contractor every 2 years in accordance with the RL Integrated Management System *Assessments* procedure. These fire protection programmatic assessments are performed by a qualified Fire Protection Engineer and other support with qualifications and experience necessary to address Fire Protection Program elements.

To assist in the conduct of this assessment, RL developed an implementation plan on May 30, 2002, and formed a multidisciplinary team of experts from the fire protection industry with knowledge and experience in fire protection engineering from other DOE sites (e.g., Rocky Flats, Hanford, Savannah River, Pantex Plant, Idaho National Environmental Laboratory, Nevada Test Site, and Oak Ridge sites). These experts also had experience in nuclear safety, fire hazard analysis (FHA), life safety, and assessment process methodology.

The implementation plan was executed following an operational readiness type of approach. The process utilized a systematic execution of the Criteria Review and Approach Documents (CRAD) included in the implementation plan. Team members were assigned individual assessment areas based on their area of expertise to address the ten individual CRADs.

The Fire Protection Program area CRADs included in this assessment were developed to address the program and facility-related elements contained within DOE Guide 420.1, *DOE Implementation Guide for use with DOE O 420.1 and DOE O 440.1, Fire Safety Program* as required by DOE Order 420.1, *Facility Safety*, RL Implementing Directive (RLID) 420.1, *Fire Protection*, Section 8.10, and Contract Requirements Document (CRD) 420.1 supplemental. The fire protection assessment evaluated compliance with RLID 420.1 and DOE Order 420.1, which were in the Fluor Hanford, Inc. (FHI) contract at the time of the assessment. The assessment also focused on the core fire protection elements that are also included in the CRD 420.1 supplemental, which was recently forwarded by RL letter 02-PRO-0817, dated May 7, 2002, stating RL's intent to include the CRD 420.1 supplemental directive into FHI's contract and cancel RLID 420.1.

The Assessment Team utilized a graded approach to address each CRAD area and also focused on Fire Protection Program implementation in an array of key FHI facilities to obtain an overall evaluation of program implementation effectiveness in FHI operations.

## **SCOPE OF ASSESSMENT**

The purpose of this assessment was to determine the appropriateness and effectiveness of the FHI Fire Protection Program. This assessment included an evaluation of specific Fire Protection Program and facility-related elements necessary to determine if FHI is meeting DOE expectations regarding fire protection and whether or not fire safety is being appropriately implemented in FHI-operated facilities.

The assessment requirements in the CRADs provided a consistent overall framework for assessments of the Fire Protection Program. Using a graded approach, the fire protection elements assessed in the CRADs included the following:

- Comprehensiveness of the Fire Protection Program
- Procedures for engineering design and review
- Procedures for maintenance, testing, and inspection
- Fire protection engineering staff (number, qualifications, training)
- Management support
- Exemptions and documented equivalencies.

This review also focused on Fire Protection Program implementation in an array of key FHI facilities, including T Plant, 222-S Analytical Laboratory, K Basins, Canister Storage Building, Cold Vacuum Drying Facility, Waste Encapsulation Storage Facility (WESF), 327 and 324 Buildings, and the 242-A Evaporator. These facilities were selected because they represent a wide array of new and existing facilities that have either a short or long mission life at the Hanford Site. Other key facilities such as the Plutonium Finishing Plant, Central Waste Complex, and the Waste Receiving and Packaging (WRAP) Facility were not chosen to be observed during this review specifically because they are the subject of other fire-related assessments (i.e., EH-2 review) that have been recently completed or they have been intensely reviewed by RL in the past year in support of a wide array of FHA and Authorization Basis reviews related to fire protection.

The Assessment Team did not perform a complete review of all fire protection features of individual specific facilities. Rather, the team performed graded facility tours to provide input regarding the effectiveness of the Fire Protection Program implementation. While the facility portion of this assessment was not intended to be an intense surveillance of every facility due to the limited time to perform this assessment, it was intended to obtain an overall view of the Fire Protection Program implementation effectiveness in FHI-operated facilities.

The Assessment Team utilized the CRADs to review existing facility fire protection assessments, facility FHAs and Authorization Basis Documents, facilities, and fire protection engineering programs; conduct support personnel and management interviews; and facility tours, to evaluate program implementation flow down to facilities for the following elements:

- Fire protection of safety class equipment
- Life safety considerations
- Fire protection of high-value property
- Fire suppression equipment

- Completeness of FHAs and integration with safety analyses
- Fire barrier integrity
- Completeness of fire-loss potential (maximum possible fire loss [MPFL]/maximum credible fire loss [MCFL]) determinations
- Fire safety training
- Inspection, testing, and maintenance reports
- Adequacy of facility assessments reports
- Administrative controls
- Temporary protection and compensatory measures
- Conformance with applicable Orders, codes and standards
- Wildland fire hazards to facilities.

Since the Fire Department emergency elements were evaluated by the DOE Office of Environment, Safety, and Health Oversight during the Hanford Site Comprehensive Fire Safety Review during August 2001 and the Fire Department completed the updated Hanford Site Needs Assessment in June 2002, the emergency response forces within FHI were not included in this assessment.

The Assessment Team was comprised of technical experts who are independent from the facilities toured during this assessment (e.g., they have no direct responsibility or assignment from the facilities mentioned in this assessment.) Resumes are included at the end of this report.

## **BACKGROUND**

### **The U.S. Department of Energy/ Hanford Site**

The 1,518-square kilometer (586-square mile) Hanford Site, located in southeastern Washington State, was acquired by the Federal Government in 1943 for the construction and operation of facilities to produce plutonium for national defense. The Site, which is managed by DOE, has been used for a variety of purposes, including plutonium production, chemical processing, waste management, and research and development activities.

At the Hanford Site, RL and the DOE Office of River Protection rely on a team of contractors to carry out mission requirements for cleaning up the legacy of nearly five decades of support to the nation's defense. Contractors at the Hanford Site are selected based on individual areas of expertise, primarily management of site operations, environmental restoration, research/development, and health services. Both DOE offices at the Site provide policy and direction, contractors' conduct the work, and the DOE offices oversee their performance in meeting mission objectives.

While each contractor has specific areas of responsibility within the Hanford Site cleanup program, they work together when necessary to ensure that programs, projects, and activities at the Hanford Site are coordinated and accomplished efficiently with emphasis on safety of the workforce and the public, and protection of the environment.

### **Fluor Hanford, Inc.**

FHI is the primary management contractor for the Project Hanford Management Contract (PHMC). The PHMC provides DOE with a prime contractor, principal subcontractors, and other subcontractors as needed to manage and integrate a full range of work to support cleanup at the Hanford Site. FHI has the ultimate responsibility for the entire project and is responsible for conducting business in such a way as to be consistent with the following outcomes, which flow from the Hanford Strategic Plan:

- Restore the River Corridor for multiple uses,
- Transition the Central Plateau to support long-term waste management, and
- Use assets to solve global problems.

### **Central Plateau Area**

The Central Plateau is approximately 195 square kilometers (75 square miles) near the middle of the Hanford Site and includes the 200 East and 200 West Areas. The 200 Areas are home to a large number of facilities formerly used for spent nuclear fuel processing and plutonium metal production, and to the Site's 177 underground high-level radioactive waste storage tanks, which are managed by the DOE Office of River Protection. Central Plateau Area facilities toured in this assessment included the 242-A Evaporator, T Plant, and WESF.

## **River Corridor Area**

The River Corridor Area consists of about 544 square kilometers (210 square miles) beginning at the shores of the Columbia River and extending inland toward the Central Plateau in the middle of the Hanford Site. The entire area includes nine former plutonium production reactors and dozens of associated structures, nearly 900 waste sites spread over 544 square kilometers (210 square miles), and about 150 unneeded and aging facilities/structures in the 300 Area, including two complex radiological laboratories. River Corridor Area facilities toured in this assessment included the 324 and 327 Facilities.

## **Waste Management Project**

The Waste Management Project under FHI provides for the safe storage, treatment, and disposal of solid and liquid waste, both legacy and newly generated, in accordance with applicable federal and state laws and regulations. Some solid wastes are directly disposed without treatment, whereas other solid waste (e.g., transuranic waste) is stored and treated before onsite or offsite disposal. Handling and treatment facilities are being built for the interim management and preparation of solid waste for final disposal. The FHI Waste Management Project has several activities under its direction, including T Plant; Solid Waste Operations (low-level burial ground and the Central Waste Complex waste storage facilities); WRAP; the WESF; the Liquid Waste Processing Facilities (200 Area Treated Effluent Disposal Facility, Liquid Effluent Retention Facility, the 300 Area Treated Effluent Disposal Facility, and the 242-A Evaporator); the Transuranic Waste Program, and the Waste Services Organization. Waste Management Project facilities toured in this assessment included T Plant, WESF, and the 242-A Evaporator.

## **Spent Nuclear Fuel Project**

The Spent Nuclear Fuel Project under FHI supports the Hanford Site cleanup mission by providing safe, economic, and environmentally sound management of Hanford's spent nuclear fuel in a manner that places the fuel in dry, interim storage, and deactivates the 100-K Area facilities. The Spent Nuclear Fuel Project was formed specifically to address the urgent need to move spent fuel from the present degraded wet storage conditions in the 105-K East (KE) and the 105-K West (KW) Basins in the 100-K Area on Hanford's Central Plateau. Spent Nuclear Fuel facilities toured in this assessment included the 105-KE Basin, 105-KW Basin, Canister Storage Building, and the Cold Vacuum Drying Facility.

## **Hanford Site Operations**

Hanford Site Operations, under FHI, provides infrastructure-related support services to the Hanford Site. The organization includes, but is not limited to, a wide range of services including communications, water utilities and water treatment plants, roads and electrical service, and security and emergency services, including the Hanford Fire Department (HFD). Hanford Site Operation toured during this assessment included the 222-S Analytical Laboratory.

## **Hanford Fire Department**

The HFD provides a variety of site-wide services including incident command; fire suppression; emergency medical services; hazardous materials, chemical, biological, and radiological emergency response; special and technical rescue; fire marshal overview authority; pre-fire planning; fire prevention education; fire watches; building inspections; ignitable and reactive waste site inspections; hazardous chemical inventory updates; and functional testing and maintenance of respiratory protection equipment. The Fire Department operates and maintains four fire stations and two maintenance facilities and has the capability to respond to mutual aid and state mobilization agreements. The department also provides emergency support to Energy Northwest, Laser Interferometer Gravitational Wave Observatory, US Ecology, and various commercial entities operating onsite through requests for service from RL.

### **Fire System Testing and Maintenance Organization**

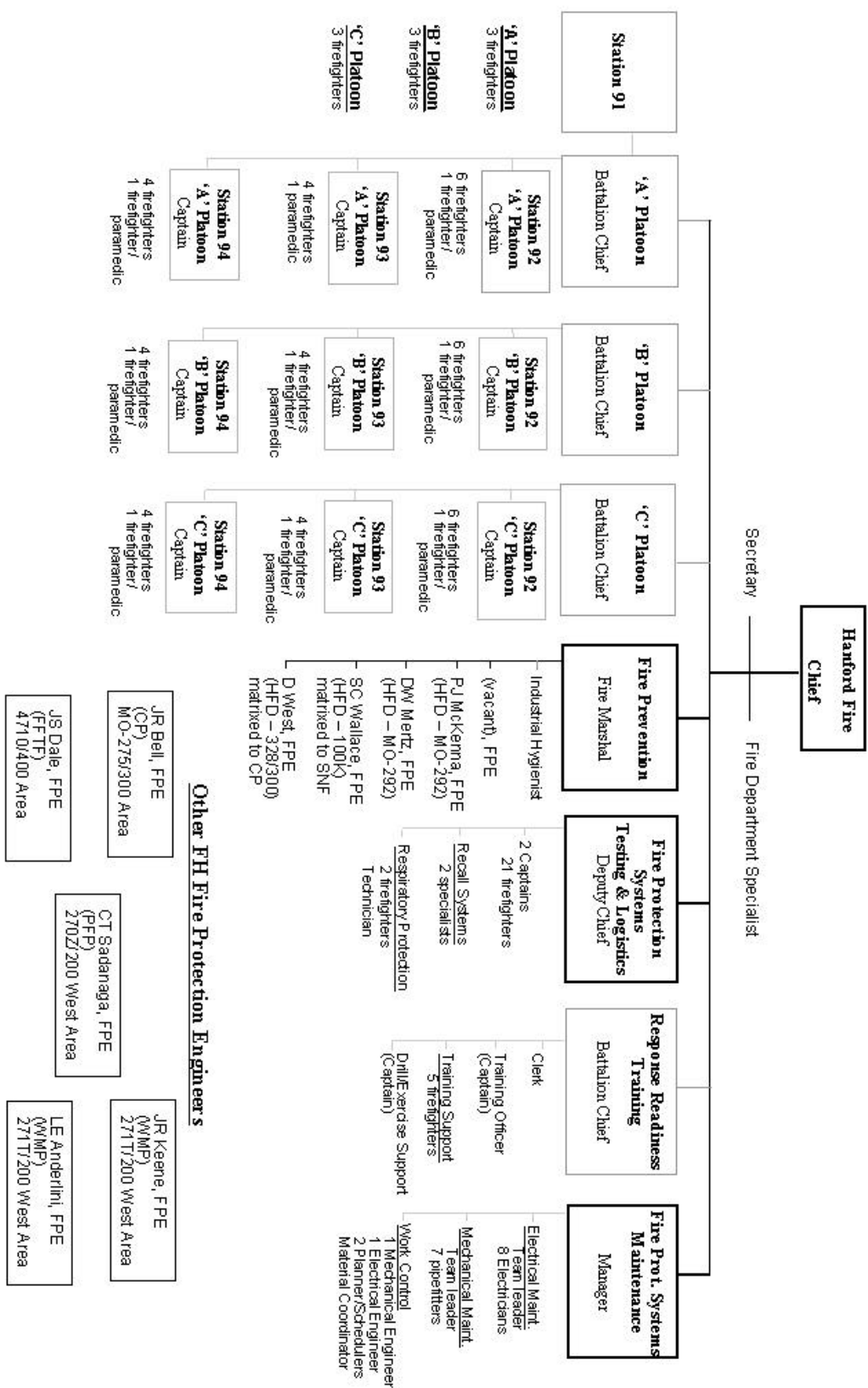
The Fire System Testing and Maintenance (FST&M) Organization, within the HFD, provides functional testing, inspection, and preventive and repair maintenance support activities for Hanford Site fire alarm and suppression systems to meet National Fire Protection Association (NFPA) and DOE standards and requirements.

### **The Hanford Fire Marshal**

The Hanford Fire Marshal is the team leader of the Prevention Division within the HFD and has the authority to develop, administer, and enforce the Fire Prevention Program for the Hanford Site under the *Authority, Responsibility, and Duties of the Hanford Fire Marshal*, which are reviewed and written by the Hanford Fire Protection Forum, and then granted by RL and ORP. The Fire Marshal's Office provides technical expertise to achieve DOE's fire protection goals and requirements, and establishes requirements that provide an acceptable degree of life safety to DOE and contractor personnel and to the public from fire in Hanford Site facilities. Under RL requirements, the Fire Marshal's Office bears the authority having jurisdiction responsibility for approving routine fire protection equipment, materials, installation, operational procedures, and routine fire protection code interpretations.

### **Fire Protection Engineering**

To accomplish the activities of the Fire Marshal's Office, qualified fire protection engineers and fire protection staff are required to be provided in the Fire Marshal's organization as necessary to perform the functions and meet the objectives of the DOE Fire Protection Program (see Figure 1). Presently, there are four fire protection engineers and one fire protection engineering vacancy directly under the Fire Marshal's Office and five non-aligned fire protection engineers assigned to specific FHI Project areas. In addition, using a Deputy Fire Marshal program and interface agreements with contractors not directly responsible to FHI, the Fire Marshal ensures a high level of consistency across the Site relative to fire prevention, engineering, and hazard mitigation activities. The fire protection engineers under the Fire Marshal's Office support a wide array of coordinated fire protection engineering services including design review, engineering, FHA and safety analysis support, fire prevention, and hazard mitigation activities.



**Figure 1. Hanford Fire Department Organization.**

## ASSESSMENT RESULTS

This section presents the overall assessment results of the FHI Fire Protection Program. The assessment followed the CRADs contained in the *Implementation Plan for the Assessment of Fluor Hanford, Inc. Fire Protection Program*. The implementation plan CRADs were developed to address the following program and facility-related elements contained within DOE Guide 420.1, *DOE Implementation Guide for Use with DOE Order 420.1 and DOE Order 440.1, Fire Safety Program*, as required by DOE Order 420.1, *Facility Safety*:

- Comprehensiveness of the Fire Protection Program
- Procedures for engineering design and review
- Procedures for maintenance, testing, and inspection
- Fire protection engineering staff (number, qualifications, and training)
- Management support
- Exemptions and documented equivalencies
- Fire protection of safety class equipment
- Life safety considerations
- Fire protection of high-value property
- Fire suppression equipment
- Completeness of FHAs
- Fire barrier integrity
- Completeness of fire loss potential (MPFL/MCFL) determinations
- Fire safety training
- Inspection, testing, and maintenance reports
- Adequacy of facility assessments reports
- Administrative controls
- Temporary protection and compensatory measures
- Conformance with applicable Orders, codes and standards
- Wildland fire hazards to facilities

For facility-related elements, the assessment focused on Fire Protection Program implementation in key FHI facilities, including Spent Nuclear Fuels, those located on the River Corridor, Site Operations, and Waste Management facilities (T Plant, 222-S Analytical Laboratory, K Basins, Canister Storage Building, Cold Vacuum Drying Facility, WESF, 242-A Evaporator, and the 327 and 324 Buildings).

Since the HFD emergency elements were recently evaluated by the DOE Office of Environment, Safety, and Health Oversight during the Hanford Site Comprehensive Fire Safety Review in August 2001, and FHI revised their fire department baseline needs assessment in the *Hanford Site Emergency Needs*, Revision 1, dated June 2002 (HNF-SP-1180, Rev. 1), the emergency response elements contained in DOE Guide 420.1 and DOE O 440.1 within FHI were not included in this assessment.

The overall purpose of this assessment was to evaluate the appropriateness, effectiveness, and implementation of the FHI Fire Protection Program by examining the program implementation in

key FHI-operated facilities. The assessment determined a number of positive outcomes, as well as issues that require the attention of the contractor. The details surrounding the results, including how the review was conducted, documents reviewed, and personnel interviewed are provided in the Detailed Assessment Results section.

The remainder of this section summarizes the results of each of the CRAD areas contained in the detail section of the report:

### **Fire Hazard Analyses**

The purpose of the FHA objective area was to determine if the contractor has implemented an appropriate FHA program. This assessment area also determines if FHAs are developed for all new facilities and existing nuclear facilities, and a process is in place to update the FHAs and ensure they reflect facility fire hazards and are consistent with Authorization Basis Safety Documents.

The Assessment Team reviewed approximately 20 specific facility FHAs and Authorization Basis Documents of facilities listed in the assessment implementation plan. FHA reviews included T Plant, 222-S Analytical Laboratory, K Basins, CSB, Cold Vacuum Drying Facility, WESF, 327 and 324 Buildings, and the 242-A Evaporator. The Authorization Basis reviews included T Plant, 222-S Analytical Laboratory, CSB, WESF, 324 Building, and the 242-A Evaporator. The team also reviewed several contractor procedures and interviewed RL Facility Representatives, Facility Safety Analysts, and fire protection engineers to address this area.

The following conditions were identified:

1. Controls, conditions and assumptions of FHA documents do not always flow down into facility controls. This was specifically noted in the 222-S Analytical Laboratory FHA where the fire analysis states (Section 1.3, first paragraph) that the types and quantities of combustible materials found during a facility tour are representative of the potential fire hazards in the lab and that a greater combustible inventory could affect the analyzed fires. However, no formal combustible control procedure or program (other than for flammable liquids under NFPA 45) exists for the laboratory to ensure that the fire analyzed by the FHA will not be exceeded by additional inventory into the laboratory. Additionally, combustible loading limits defined by the 242-A Evaporator FHA (Section 6.4.1) have not been incorporated into facility specific procedures to ensure that limits will not be exceeded. The 242-A Evaporator has declared a PISA and a positive USQ and a developed a Justification for Continued Operation (JCO) which was approved by DOE August 09, 2002.
2. FHI does not currently have or maintain a comprehensive list of facilities that minimally require an FHA to be performed. While a method of tracking the existing FHAs is available, there is no method to ensure that the facilities required by DOE directives to have an FHA do, in fact, have one.
3. Due to the changing operations and activities, the FHAs do not always capture the current fire hazards. Some examples are noted below:

- The FHA for the CSB evaluates several scenarios in the operational area and provides a basis for establishing combustible controls. However, a hydraulic fluid fire (pressurized-spray fire) was not considered in the Canister Storage Building FHA for the MCO Handling Machine (MHM) which contains over 50 gallons of combustible hydraulic fluid, and may pose a significant hazard to safety-class equipment in the CSB. The Canister Storage Building has declared a PISA on November 14, 2002, and is in the process of evaluating this concern.
- The FHA for the 327 Building evaluated most of the significant hazards in the facility and provides conservative conclusions. However, the 327 FHA did not fully address fire scenarios in the basement, particularly the "Class A" fuel packages that were observed during the assessment that could expose the unprotected structural steel. The FHA evaluated only a large ventilation-limited hydraulic fluid fire in the basement and concluded that structural failure is not likely. This FHA concluded that this fire would bound all others, although a smaller "Class A" fuel package or possibly a pressurized-spray fire could damage the steel (not ventilation limited where critical temperatures could be reached) and cause openings to develop in the floor. This is of particular concern because the same fire could also cause a radiological contamination release from the high efficiency particulate air filters. After the assessment, the facility removed a considerable amount of combustible materials from the basement to address this concern. However, formal controls to maintain combustibles at a safe level were not in place and the fire hazard analysis did not analyze for the "Class A" combustibles that were stored in the basement at the time of the assessment. Subsequently the 327 Facility has declared a PISA on November 08, 2002, and is in the process of evaluating the concern.
- The FHA for T Plant focuses on fire scenarios in the canyon area and provides recommendations for limiting the growth of fires in this area. Scenarios are also evaluated in the office areas (271-T). The building has since implemented the controls and the configuration in the canyon area is markedly improved. However, there was a significant accumulation of combustible materials in other areas that were not considered in the FHA, notably the pipe and electrical galleries. There is the potential for a post-flashover fire in these areas that could compromise the rating of the fire doors and possibly spread to other areas. There are no combustible controls enforced in these spaces. This is not a nuclear safety concern. However, T-Plant is addressing the issue under life safety code of NFPA 101.
- The FHA for the 105-KE Basin captures the most severe hazards, but should be expanded to consider large "Class A" combustible fuel packages in and around the Transfer Area. This is predicated on the current presence of scaffolding, wood crates, and a canister cleaner structure with polymer windows being present in the Transfer Area. These items may be staged near unprotected structural steel and/or safety class equipment. There is also no direct control on the maximum quantity of these materials, indicating that accumulations could exceed the fire scenario fuel load assumed in the FHA in this area. While FHI procedures allow flame resistant treated wood to be used in these facilities, flame resistant treated wood is still a combustible material that should be analyzed and controlled in facility usage.
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4. The FHAs do not incorporate wild land fire hazards as required by the *Initial Joint Review of Wildland Fire Safety At DOE Sites*. While inclusion of direct fire hazards are addressed in some FHAs, indirect fire and smoke hazards, as identified in the *Joint Review*, are not. While the incorporation of wildland fire hazards into the FHA is not required by the contract until a modification implementing the inclusion of CRD 420.1 supplemental is made, the *Initial Joint Review of Wildland Fire Safety At DOE Sites* report has been out since December 2000 and the contractor could have easily incorporated these concerns into their FHAs during revisions with minimum efforts.
5. There are long-standing FHA recommendations that have not been corrected and are not being tracked.
6. There are Facility Authorization Basis Documents and FHAs that are not fully integrated. Generally, the FHA postulates fire scenarios that exceed those considered in the Authorization Basis Documents. This is partially the result of the FHA and Authorization Basis Requirements Documents that specify assumptions and the focus of the analysis. Improved coordinated integration is needed between these two documents relative to fire hazards and where there are differences, the documents should address the differences and justify the reasons.

Based on the identified deficiencies, the criteria, review and approach elements of the FHA area have not been met.

### **Protection of Safety Equipment, Mission, Property, and Environment**

The purpose of the protection of safety equipment, mission, property, and environment objective area was to determine if the contractor demonstrates sound fire protection engineering practices consistent with DOE requirements necessary to protect safety related equipment, vital programs and missions, property, and the environment. To evaluate this the Assessment Team reviewed approximately 20 FHAs and safety basis-related documents, 6 facility specific fire protection assessments, and 12 other documents, including prefire plans, procedures, directives, and memorandums. Additionally, the Assessment Team interviewed project fire protection engineers and RL Facility Representatives and conducted facility walk down tours of T Plant, 222-S Analytical Laboratory, K Basins, CSB, Cold Vacuum Drying Facility, WESF, 327 and 324 Buildings, and the 242-A Evaporator to observe practical Fire Protection Program implementation in this area.

Overall, the Assessment Team concluded that fire protection requirements for safety class systems are not always specifically mentioned in FHAs as required by DOE. Additionally, in some cases Authorization Basis Documents updates were made that added safety class equipment that were not updated in the FHA, and fire impacts to safety class systems were not always considered in sufficient depth in FHAs and Authorization Basis Documents. The team also determined that there were some facilities that do not meet DOE requirements for loss limitations because FHA recommendations remain open. Furthermore there were inconsistencies between hose stream requirements contained in the prefire plan verses the FHA exist. Improved coordinated integration is needed between the prefire plan and the FHA relative to hose stream requirements and where there are differences, the documents should address the differences and note the reasons. Disparities in the hose stream requirements creates confusion

as to what the actual hose stream demand is and whether or not the water supply is capable of supplying the hose stream demands.

The following conditions were identified:

1. Protection of safety class equipment from fire exposures is not adequately addressed in the FHA. The FHA documents do not discuss the safety class function that is required and the potential impact of a fire (or fire protection systems) on the safety function. Where there is the potential for damage to this equipment or these systems, the FHA should provide recommendations for mitigation. This needs to be coordinated with the Authorization Basis Documents. The FHAs do not adequately address Section 4.2.1 of DOE 420.1 with respect to the safety class equipment.
2. DOE loss limitations are not completely addressed in FHA documents. There are examples where the FHA identifies scenarios that exceed recommended loss limitations and provides recommendations, but the recommendations remain open.
3. The water supply (demand) is not consistent between the FHA and the prefire plans. Cases are identified where the difference is significant (more than 50 percent). The FHA and prefire plans inherently use different assumptions for determining the maximum water demand. The FHA calculation is performed to assess the adequacy of the water delivery system and should thus be the bounding value. In some instances, the prefire plan water demand estimates are significantly greater than the estimates in the corresponding FHA documents. This observation is not directly related to the subject of this CRAD and was not fully investigated. However, disparities in the hose stream requirement creates confusion as to what the actual hose stream demand is and whether or not the water supply is capable of supplying the hose stream demands

The criteria, review and approach elements of this area is not considered to be met because the FHA documents do not evaluate the impact of various fire scenarios to safety class equipment or the safety class function as required by RLID 420.1, Section 8.11f.1.(f) (and CRD [supplemental] 420.1) and HNF-RD-9390, Section 2.2. Per DOE Order 420.1 and RLID 420.1 (and CRD [supplemental] 420.1), certain protection measures are necessary depending on the nature of the safety class function (redundant or otherwise). The FHA documents are not consistent in identifying this level of protection.

Consequently, although several supporting objectives within the criteria, review and approach elements are satisfactorily met, the most significant aspects were not.

### **Administrative Controls and Compensatory Measures**

The purpose of the administrative controls and compensatory measures objective area was to determine if the contractor maintains an appropriate method of establishing, identifying, tracking, and maintaining administrative controls and compensatory measures relative to fire protection.

Administrative controls and compensatory measures usually address concerns of limiting fire conditions (generally via ignition control or combustible loading) or concerns of inadequate or out-of-service fire protection systems. Since both of these concerns are driven by the DOE fire

protection related codes and standards, the impacts can be to life safety, worker safety, property protection, or protection of designated safety equipment. Therefore, administrative controls and compensatory measures require significant attention so that their intent and purpose are maintained.

To review the criteria, review and approach elements of this area, the Assessment Team reviewed approximately 40 documents, including, but not limited to, contractor program procedures and round sheets, facility specific surveillances, hot work permits, exemption and equivalency requests and approvals, and operating procedures. The team interviewed RL Facility Representatives, fire protection engineers, and operational supervisors. The team also conducted tours of T Plant, 222-S Analytical Laboratory, K Basins, CSB, Cold Vacuum Drying Facility, WESF, 327 and 324 Buildings, and the 242-A Evaporator.

The Assessment Team concluded that the main administrative controls and compensatory measures objective was not fully met because the facilities do not have a central means of tracking, initiating, cross-referencing, and managing administrative controls and compensatory measures. In addition, there are implicit (and to a lesser extent explicit) controls in the FHA and Authorization Basis Documents that are not implemented in any way. In some cases, Exemptions and Equivalencies are based on implied and/or explicit FHA controls. Because these controls are not always implemented at the facility level, there is a potential for exemptions and equivalencies to be violated.

Analyzing combustible controls at FHI high-risk facilities, FHI continues to identify deficiencies and improve alignment between the FHAs and AB. Recent AB updates, the USQ evaluation process and the declaration of PISAs, subsequent positive USQs, and deliberate compensatory measures through the JCO process over the last two years have resulted in much improved combustible controls at these facilities. Examples include PFP, WRAP, CWC, WESF, and 242-A. Also, prior to operation in December 2000, the Spent Nuclear Fuel Project established explicit conservative controls consistent with the FHA and AB. As a result of this report, PISAs were declared at 242-A, 327, and CSB. As part of the corrective actions associated with the 2001 Office of Environment, Safety, and Health Comprehensive Fire Safety Review of the Hanford Site Report, FHI currently is assessing the adequacy of the combustible controls for all Category 1,2 and 3 nuclear facilities. Results of this FHI assessment are expected sometime in November 2002.

The following conditions were identified:

1. There are implicit (and to a lesser extent explicit) controls also described in the FHA documents that are not implemented in the facility in any way. In some cases, exemptions and equivalencies are based on implied and/or explicit FHA controls. Because these controls are not always implemented at the facility level, there is a potential for exemption and equivalencies to be violated. These controls may impact operational safety requirements for the facility and may impact fire safety equivalencies and exemptions. Implicit controls are directly related to the accident and fire scenario assumptions in the FHA and Authorization Basis Documents and are difficult to capture. However, these assumptions may include the combustible load, configuration, facility makeup, and the ventilation conditions. This disconnect may arise because the FHA evaluations tend to focus on the most severe hazard that currently exists in a facility

rather than attempting to determine the most severe condition that the facility can tolerate (i.e., a limiting scenario).

2. Controls used as the basis for exemptions and equivalencies are not tracked and monitored. As a result, conditions may arise that invalidate a particular exemption or equivalency.
3. There is no centralized means of initiating, tracking, cross-referencing, and managing administrative controls at the building level and there is the potential for combustible loads and fire conditions to exceed levels analyzed in the authorization basis and FHA documentation.

Based on the identified deficiencies, the criteria, review and approach elements of the Administrative Controls and Compensatory Measures area have not been fully met.

## **Fire Prevention**

The purpose of the fire prevention objective area was to determine if the contractor has implemented an appropriate Fire Prevention Program which includes periodic fire prevention inspections, procedures or methods for controlling combustible, flammable, radioactive or hazardous materials to minimize the risk from fire, smoking restrictions, and hot work controls and procedures.

During the course of the fire prevention area review, the Assessment Team interviewed operation supervisors, DOE facility representatives, and fire protection engineers. Over 30 individual documents were reviewed, including facility-specific work permits and round sheets, facility and company-wide administrative procedures, program requirements, and facility-specific FHAs. In addition, to validate vegetation management implementation (as well as review other CRAD areas), the Assessment Team toured T Plant, the 222-S Analytical Laboratory, K Basins, the Canister Storage Building, the Cold Vacuum Drying Facility, WESF, the 327 and 324 Buildings, and the 242-A Evaporator.

The following conditions were identified:

1. FHI is maintaining appropriate vegetation control around their facilities. Clearing debris is an important part of protecting facilities from the effects of a wildland fire.
2. FHI is using the hot work procedure based on the Fire Marshal permit system, which is based on NFPA and DOE requirements. As decommissioning and demolition of legacy facilities escalates, continued attention to minimizing fires from hot work will be required.
3. Discrete housekeeping and combustible controls were generally too vague or nonexistent for a number of FHI facilities. In addition, procedures that require facilities to “minimize combustibles” are not effective since there could be more combustibles in the facility than analyzed in FHAs or Authorization Basis Documents. This was also noted in the October 2001 Office of Environment, Safety, and Health Comprehensive Fire Safety Review of the Hanford Site Report of October 2001 page 12, where it was concluded that “the established program to control excessive accumulations of combustible materials and possible ignition

sources within the Plutonium Finishing Plant is not fully effective. Examples observed during the tour included staged waste accumulation awaiting removal from facility decommissioning and demolition in the building 327 hot cell area, wood scaffolding accumulation in the 105-KE Basin (note: while some of the wood used in these facilities may be flame resistant treated wood it is still a combustible material that should be analyzed and controlled in facility usage), and the storage of palletized combustible materials in the T Plant pipe and electrical gallery. While these items individually do not necessarily represent a specific facility fire safety issue, the question of “how much combustible materials becomes too much combustible material” is presented where the areas and material hazards utilized have not been analyzed and controlled. The team did observe discrete combustible controls implemented in the 324 and 327 hot cells (but not in the rest of the facility), in WESF, and in the operational area of the Canister Storage Building. Additionally, the 222-S Analytical Laboratory housekeeping was good and there were controls for flammable liquid; however, controls to maintain the housekeeping at an acceptable level was not specifically written for the laboratory.

Overall, the Assessment Team concluded that the fire prevention criteria, review and approach elements of this area were not fully met because there are some areas that require improvement, specifically the depth of the combustible control/housekeeping procedures.

### **Fire Protection Program**

The purpose of the Fire Protection Program objective area was to determine whether or not the contractor has a comprehensive Fire Protection Program necessary to meet DOE fire safety objectives and if management demonstrates the necessary commitment to the Fire Protection Program.

During the course of the Fire Protection Program review, approximately 20 documents and procedures were reviewed, engineering and management staff were interviewed, and the Assessment Team conducted tours of T Plant, 222-S Analytical Laboratory, K Basins, Canister Storage Building, Cold Vacuum Drying Facility, WESF, 327 and 324 Buildings, and 242-A Evaporator.

The following conditions were identified:

- Overall, the Fire Protection Program is well documented, with assigned roles and responsibilities well defined and known.
- FHI places a high priority on fire safety at the Site through appropriate organizational structure, attention to Fire Protection Programs, and demonstration of basic fire safety practices and methods by all personnel levels.
- There is concern regarding funding for continued capability of the centralized fire protection organizations – Fire Marshal’s Office, and inspection, testing, and maintenance teams – to continue with the high level of service currently provided given the known increasing programmatic expectations and change in mission. Existing funding practices are expected to limit currently acknowledged noteworthy practices (such as the Fire Marshal’s permitting

process), and impact programmatic implementation of DOE-mandated programs (such as self-assessments).

- While recommendations and deficiencies from FHA documents are entered into commitments tracking systems as they are created or updated, previous recommendations (generated previous to approximately January 2000) that have not yet been addressed have not been entered into any such tracking systems.
- There are several concerns regarding exemptions, equivalencies, and deviations. While there is a process for requesting exemptions, equivalencies, and deviations contained in HNF-8663, there is no method for maintenance, revision, or cancellation of the documents. In addition, no method is currently present to provide a clear understanding of which exemptions, equivalencies, or deviations are applicability to a given facility or program element, what the specific controls are (if any), and if the document is still currently under consideration of contractual, facility, or conditional changes. Also, the linkages and flow of administrative controls from exemptions, equivalencies and deviations to facility-level control documents is not well defined.
- The current method for granting deviations or variances to FHI processes and procedures raises questions regarding the limits of authority of the Fire Marshal, as opposed to RL, in allowing modifications to application of national codes and standards. A clear line of authority needs to be developed.

Overall, the FHI Fire Protection Program is acceptable, and the team concluded that the criteria, review and approach elements of this area were met.

### **Self-Assessments**

The purpose of the self-assessment objective area was to determine if documented Fire Protection Program self-assessments and facility assessments are being conducted in accordance with DOE expectations.

In support of this area, the Assessment Team reviewed approximately 20 individual documents, procedures, fire protection facility assessments, Facility Evaluation Board reports, and letters relative to fire protection assessments. The team also interviewed a number of fire protection engineers and the Fire Marshal. The team considered the element contents expected to be included in the assessments, completeness of assessments, and frequencies of assessments in accordance with DOE contract requirements.

The following conditions were identified:

1. Fire Protection Program assessments are not performed on a periodic basis as required in RLID 420.1 and HNF-RD-9391.
2. Administrative controls contained in facility fire hazards analyses do not appear to be adequately addressed in facility fire protection assessments.

3. The 105-KE and 105-KW Basins fire protection facility assessment is overdue. The last facility assessment for the 105-KE and 105-KW Basins was completed in December 1997 and the FHA was last updated in January 2002. While the FHA addresses some of the facility assessment elements and the information used in the FHA may be referenced in the facility assessment, a documented facility assessment needs to be completed.

Based on the identified issues and deficiencies, the criteria, review and approach elements of the self-assessment area have not been fully met.

### **Fire Protection Engineering**

The purpose of the fire protection engineering objective area was to determine if the contractor has an adequate number of qualified and trained fire protection engineers necessary to ensure that requirements of the Fire Protection Program are being incorporated into the design and operation of contractor facilities.

The assessment of the fire protection engineering area reviewed over 20 documents related to project management, design, construction, qualifications, and other technical documents. The Assessment Team also conducted several interviews with management, fire and project engineers, and the Fire Marshal to determine if the capability existed to ensure that the appropriate requirements of the DOE Fire Protection Program are being incorporated into design and operation of site facilities.

The following conditions were identified:

1. Overall, the Fire Protection Engineering Program is adequate, with engineers that meet the definition of "qualified" (as delineated in RLID 420.1 and CRD 420.1 supplemented) and that have the requisite knowledge to perform assigned job duties.
2. Professional development training for Fire Protection Engineering professionals is limited and restricts the capabilities available to the site in general.
3. The training and qualifications of the site fire protection engineers does not provide for in-house performance of analytical evaluations such as fire modeling or assessment of hazardous conditions via calculations. While current practice is to obtain such services from sources outside the site, the alignment of the FHA and Authorization Basis Documents is expected to increase the need for site-based knowledge.
4. Conversations with the Fire Marshal and project fire protection engineers indicate there are concerns regarding the inclusion of fire protection personnel in review and approval of work packages that influence fire protection and life safety issues. This was further documented in the 1999 Hanford Site Fire Protection Engineering Value Engineering Study where fire protection engineer input was not considered in projects like the Effluent Treatment Facility and the Waste Receiving and Processing Facility. The lack of fire protection engineer input into these projects resulted in fire protection design deficiencies that required costly change orders. The conditions are improving as the result of efforts by the Fire Protection Forum and Fire Marshal, as well as changes in work control documents. Continued improvement is

expected both due to these improvements and the continuing education of work control managers.

While continuous improvement is needed in work control documents to incorporate fire safety input, and advanced analytical staff capabilities to support fire hazard evaluations are needed, based on the role and continued positive influence of the Fire Marshal's office on facility engineering coupled with the current engineering staff under the Fire Marshal's Office, the overall conclusion of the Assessment Team was that the criteria, review and approach elements of the fire protection engineering area were met.

### **Fire Safety Training**

The purpose of the fire safety training objective area was to determine if fire safety training is provided to all employees and evaluate the appropriateness of that training. During the course of this review, the Assessment Team interviewed the FHI Hanford General Employee Training point of contact and the training fire safety technical authority, along with various contractor personnel and operations supervisors to understand how the training information incorporates elements of fire safety. Four training documents were reviewed along with the actual Hanford General Employee Training modules as part of the Team's badging process.

Overall, the Assessment Team concluded that general fire safety training is provided to all contractor and subcontractor personnel under FHI and is appropriate for general employee fire safety. The fire safety training included through the Hanford General Employee Training is documented and is appropriate for general employees because it included good housekeeping practices, proper response and notifications in the event of fire, instructions on the use of portable fire extinguishers, recognition of potential fire hazards, and special extinguishing system hazards (e.g., safety training associated with halon systems), and instructions on the use of portable fire extinguishers. Employees who perform fire watches also receive hands-on portable fire extinguisher training, as required by 29 *Code of Federal Regulations* 1910.

Therefore, the team concluded that the fire safety training criteria, review and approach elements objective was met.

### **Life Safety Considerations**

The purpose of the life safety considerations area was to determine if the contractor's program had implemented effective life safety practices including basic and specialized life safety provisions that are incorporated into designs and operational facilities consistent with NFPA 101, *Life Safety Code*. In the life safety criteria, review and approach area the Assessment Team reviewed approximately 30 procedures, surveillances, work packages, and other related documents, and interviewed facility design authorities, facility managers, and fire protection engineers. The Team also observed life safety implementation in a number of facilities during the team tours at T Plant, 222-S Analytical Laboratory, K Basins, CSB, Cold Vacuum Drying Facility, WESF, 327 and 324 Buildings, and the 242-A Evaporator.

The following conditions were identified:

1. Numerous emergency lighting unit lamps within the 105-KW Basin were observed to be misaligned. Proper alignment of lamps is contained in the monthly and annual inspections; however, the procedure to conduct routine (daily/weekly) rounds of the facility does not include a check for proper lamp alignment. Isolated incidents of misaligned lamps were observed in other facilities as well. This could be indicative of procedural inadequacies or a lack of knowledge on the part of inspection personnel as to what should be checked.
2. Performance testing of emergency lighting illumination levels has not been performed. During the facility tours, it was noted that the locations/spacing of battery-operated emergency lighting units in a number of cases appeared inadequate of the performance for the overall emergency lighting system. While emergency lighting units appear to be individually tested, lighting performance throughout the required areas does not appear to be adequate in a number of facilities observed (e.g., T Plant, 105-KW Basin transfer bay, and 324 Building). A qualitative test in many of these windowless structures might be prudent to ensure employee safety during a fire or electrical outage. Although procedures are in place to perform preventive maintenance and operational checks of emergency lighting units, this does not include an assessment of the adequacy of lighting levels. A similar issue was identified at another DOE site, which resulted in the discovery of inadequate illumination (see Occurrence Report, ORO--MMES-Y12DEFPGM-1993-0093, *Defective Emergency Lighting*).

The Assessment Team also noted one isolated life safety concern. Exit signs in Building 327 direct persons through an exit door in the middle of the north exterior wall of the building. The access route passes through an overhead roll-up door, which is in violation of NFPA 101. More importantly, the Facility Manager stated that the overhead door is closed when the canyon area goes on mask. Although there appeared to be adequate egress capacity available from other areas of the building with this door closed, the elimination of this exit with the overhead door closed did not appear to have been previously considered.

Overall, the Assessment Team concluded that life safety provisions are generally maintained in existing facilities. NFPA 101 requirements are implemented into facility designs. A minimum of two paths of protected egress out of facilities was generally observed, travel distances appeared to not be exceeded, and exit signs at the appropriate places were provided. Unique fire protection features of the life safety code, such as sprinkler protection and emergency fire alarm systems, were also provided in most facilities.

With the exception of the overhead door and the emergency lighting issues, the criteria, review and approach elements of life safety were met.

### **Fire System Operability**

The purpose of the fire system operability objective area was to determine if the contractor has an adequate inspection, testing, and maintenance program and an impairment system for fire protection systems and equipment.

The Assessment Team reviewed approximately 50 individual documents to review this area, including facility inspection and maintenance procedures and round sheets, lessons learned from another DOE site, sitewide procedures, and other DOE documents. The team also utilized their

recent experience with the Hanford Fire Department Needs Assessment Review and review of the DNFSB 2000-2, *Phase II Assessment of the Central Waste Complex Fire Protection Systems* in addressing this area. The team also interviewed a number of fire protection engineers, FST&M personnel, facility managers, a water plant manager, and a site water purveyor. The team also conducted tours of T Plant, 222-S Analytical Laboratory, K Basins, CSB, Cold Vacuum Drying Facility, WESF, 327 and 324 Buildings, and the 242-A Evaporator to visually see if fire protection systems were in service (i.e., if water sprinkler systems were pressurized, sprinkler heads were unobstructed, fire alarm systems and radio fire alarm repeaters were not in a trouble condition, alarm mode had power indication, exit signs were illuminated, fire wall and doors were operational and labeled without penetrations, etc.).

Fire protection systems are being professionally inspected, tested, and maintained in accordance with NFPA standards and DOE expectations and the HFD FST&M Organizations have qualified personnel to address the fire protection systems. In addition, FHI facility personnel are inspecting and testing non-system fire protection features (e.g., fire doors, fire barriers, exit signs, etc.).

However, long-term planning and control of systems is a concern relative to fire protection water supplies. The Water Supply System Master Plan does not address long-term issues for fire protection. While the Master Plan addressed sitewide water demands, it did not address specific needs for fire suppression systems that are important to safety. Furthermore, the Master Plan did not integrate fire protection systems needs and vulnerabilities in the weighted priority replacement matrix for underground piping consistent with facility missions and future needs of these important fire safety systems.

The Utilities group does not have structured programs to interface with fire protection system owners and facilities to ensure continued service of systems. Additionally, water supply component impairments supporting fire systems are not controlled with the same formality as internal fire protection systems.

Finally, an issue regarding the lack of obstruction investigations in sprinkler piping presents the question of long-term capabilities of fire suppression systems. Essentially, internal sprinkler piping obstruction investigations per NFPA 25 are not being performed and fire sprinkler piping could be blocked. While the NFPA standard is subjective as to whether or not an obstruction investigation should be performed, no technical baseline study is present to justify the lack of performing this investigation in facility systems.

As a result of this assessment, FHI began inspections to collect baseline data, and identified debris and plugging in a number of dry pipe sprinkler systems within the Central Waste Complex (CWC). FHI continues to take appropriate compensatory measures to work through the fire protection and authorization basis issues as they arise.

Overall, the inspection, testing, and maintenance program for fire protection and life safety systems for FHI is acceptable to conclude that the criteria, review and approach elements of this area were met.



## DETAILED RESULTS

This section of the report presents a detailed discussion of the assessment and results for each topical area.

### **Fire Protection Program**

#### **Objective FP.1 – Fire Protection Program**

The Contractor implements a comprehensive Fire Protection Program.

**Supporting Objective FP.1.1.** Fire protection criteria are documented in a "Fire Protection Program". The Fire Protection Program document reflects, as a minimum:

- The Facilities and/or Areas for which the Contractor is contractually obligated;
- The organization and responsibilities of the fire protection staff;
- Administrative aspects of the Fire Protection Program; and
- Requirements for physical fire protection features.

**Supporting Objective FP.1.2.** The Contractor has management commitment to the Fire Protection Program.

**Supporting Objective FP.1.3.** The Contractor has a policy statement that implements DOE fire protection related mandatory Orders, codes and standards.

**Supporting Objective FP.1.4.** The Contractor has a method of requesting and tracking Exemptions and equivalencies to DOE fire protection related mandatory Orders, codes and standards.

**Supporting Objective FP.1.5.** The Contractor has a process for identifying, tracking, and resolving recommendations and/or findings resulting from internal and external assessments.

#### **Criteria:**

1. A Fire Protection Program exists.
2. The Fire Protection Program includes a list or reference to a list of Facilities or Areas for which the Contractor is contractually obligated to provide fire protection services.
3. The Fire Protection Program is administrated with adequate authority and has a defined path to responsible Contractor corporate management.
4. The Fire Protection Program contains specific indication of the programmatic elements for which the Contractor is contractually obligated.
5. The Contractor has a policy statement that indicates a management commitment to the Fire Protection Program and specifies the implementation of the fire protection related Orders, codes and standards to which the Contractor is contractually obligated.

6. Management demonstrates commitment to the Fire Protection Program both administratively and financially.
7. A process is defined within the Contractor organization for requesting Exemptions or documented equivalencies from the Department of Energy for fire protection related mandatory Orders, codes and standards.
8. Any requested or approved Exemptions or documented equivalencies are kept on file, maintained current, and tracked for implementation by the Contractor.
9. Recommendations or findings from assessments or evaluations, both internal and external, are tracked and dispositioned in a formal manner.

**Approach:**

1. Obtain a copy of the contract between the Contractor and the Department of Energy and determine the Orders and Standards applicable to the Contractor. Obtain and review a copy of the Contractor's Fire Protection Program. Ensure that the Fire Protection Program document is current and delineates the Orders and Standards included in the Contractor's contract with the Department of Energy. Also ensure that the Fire Protection Program document either lists or refers to a list of Facilities and Areas to which the Program applies. Validate that the list concurs with the list identified in the contract.
2. Review the Program to ensure that the topics included reflect those identified in RLID 420.1, Section 6.2. Verify sections not directly addressed as either not required or not applicable.
3. Obtain an organizational chart that defines the personnel involved with the Fire Protection Program. Determine, via documentation and interview, the lines of management and authority within the Contractor's corporate structure. Ensure that adequate weight (based on the opinion of the team lead) is given to the Fire Protection Program and its respective parts.
4. Review the corporate or company policies of the Contractor to ensure that fire protection is specifically named as a safety management program. Ensure the policy affirms the Contractor's management's commitment to support a level of fire protection and fire suppression capability sufficient to minimize losses from fire and related hazards consistent with the best class of protected property in private industry.
5. Determine, via document review or interview, how funding of Fire Protection Program elements occurs. Investigate how future funding of Fire Protection Program elements will occur and what, if any, conditions may make the funding conditional or contingent. Compare the proposed funding levels against the contractual obligations of the Contractor and known projects and programs during the contract period. Ensure that adequate, comparative funding will be provided for the expected contract period.
6. Confirm via interview with management, fire protection, building operations, and general staff (number and specific personnel to be determined by team lead) that a culture of safety exists. Interview topics include, but are not limited to:

- a. Understanding of current requirements and commitments to the Department of Energy;
  - b. Understanding of safety basis documents (such as Fire Hazards Analyses, Authorization Bases, etc.) and the requirements and recommendations contained therein;
  - c. Training, meetings, procedural development and/or root cause evaluations and their relation to fire safety;
  - d. Opinion of support by individuals by their direct management and by upper-level management;
  - e. Identification of any noted change in the perspective toward safety since the last assessment was performed or in the last year, whichever is less;
  - f. Verification of key safety basis assumptions and specific controls relative to the Fire Protection Program have been implemented.
7. Determine, via document review, if a defined method of submitting Exemption requests exists within the Contractor organization. If a method is defined, review the process to ensure that the process ensures that adequate review by fire protection personnel occurs for concerns of interest.
8. Request copies of all existing Exemptions or equivalency requests from the Contractor. Review the Exemptions or equivalency to determine if the concerns, conditions, and any compensatory actions identified are current to the project and are currently implemented within the Facility or Area to which the Exemption or equivalency request pertains. Determine if the Contractor has a method of tracking the list of Exemptions and equivalency requests proposed to and approved by the Department of Energy Richland Operations Office. Compare the list of concerns received from the Contractor to the known list of the DOE Richland Fire Protection Engineer to determine if the two groups coincide.
9. Review the Fire Protection Program to determine if the Program either identifies a specific method for receiving, tracking, and dispositioning recommendations or findings or references an established methodology within the Contractor structure. Obtain a listing of current recommendations and findings from the Contractor's listing or database. Obtain the three most recent external audits (DOE Headquarters, Defense Facilities Nuclear Safety Board [DNFSB], etc.) and determine if recommendations or findings from the reports have been incorporated (as applicable) by the Contractor into the listing or database. Obtain the two most recent internal assessments and determine if recommendations or findings from the reports have been incorporated by the Contractor into the listing or database. Request a sampling (number and type at the discretion of the team lead) of disposition documentation for completed recommendations or findings to ensure that adequate plans of action, tracking, and disposition documentation are provided.

**Basis:**

RLID 420.1, Section 6.2 [CRD 420.1, Section 4.2] requires that RL operating contractors "provide a level of fire protection adequate to meet the [fire protection] objectives" of DOE O 420.1. As such, a written Fire Protection Program document provides the base for a Contractor to ensure that these programmatic elements are accepted and understood by the Contractor's management for implementation. Definition of the applicable Orders, codes and standards under the contractual obligations agreed upon by the Contractor allows for continued application and

ensures that the goals originally intended by the Contractor are maintained. Exemption requests to Orders, codes and standards ultimately modify the contractual obligations of the Contractor and must, therefore, be maintained and updated to keep pace with project issues and performance objectives and to maintain the desired level of safety. Tracking and trending of issues, particularly those raised during internal and external assessments, is an important part of ensuring that the Program remains up to date and consistent with current safety management practices within the Department of Energy.

**References:**

DOE O 420.1, Contract Requirements Document, Sections 4.2, 4.2.1 and 4.2.2  
RLID 420.1, Section 6.2 d  
RLID 420.1, Section 6.2 e  
RLID 420.1, Section 6.2 f  
RLID 420.1, Section 6.2 g  
RLID 420.1, Section 6.2 h  
RLID 420.1, Section 6.2 i  
RLID 420.1, Section 6.2 l  
RLID 420.1, Section 6.2 q  
RLID 420.1, Section 8.3  
RLID 420.1, Section 8.10

**Interviews:**

Perform interviews with Fluor Hanford personnel, as needed, to determine health and implementation of the program. Interviewees include, but are not limited to:

- HFD Fire Marshal
- Fire Protection Engineers
- DOE Facility Representatives

Information obtained from Team members from the Hanford Fire Department Needs Assessment effort was also used.

**Observations:**

Perform surveys of facilities to obtain a general sense of program implementation.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August, 2001.
  - DOE, Richland Office Memorandum 02-PRO-0817, *Contract No. DE-AC06-96RL13200 – Supplemented Contractor Requirements Document (CRD) DOE O420.1 Change 3 (Revision 0), Facility Safety*, 5/7/02.
  - *U.S. Department of Energy Response to the 24 Command Wildland Fire on the Hanford Site – June 27 – July 1, 2000*, DOE/RL-2000-63, October 2000.

- *Comprehensive Fire Safety Review: The Hanford Site*, October 2001.
- *Initial Joint Review of Wildland Fire Safety at DOE Sites*, December 2000.
- RL letter 97-QSH-179, *Status Report of Current Environment, Safety and Health (ES&H) Exemptions, Waivers, Deviations, Equivalencies, and Variances*, dated July 8, 1997.
- Site Wide Documents:
  - DE-AC06-96RL13200, Modification M149, Part III, Section J, Appendix C, *DOE Directives* – Fluor Hanford, Inc. contract with DOE
  - Fluor Hanford, Inc. Memorandum FH-0202168A.R1, *Supplemented Contractor Requirements Document (CRD) DOE O 420.1, Change 3 (Revision 0), Facility Safety – Impacts*, 6/13/02.
  - HNF-RD-10606, Rev. 0, *Fire Protection Program Requirements*, 4/29/02.
  - HNF-8663, Rev. 0, *Fluor Hanford Requirements Management Functional Area Document*, Section 12, *Fire Protection*, 1/22/02.
  - Contractor organizational charts.
  - HNF-RD-9188, Rev. 0, *Fire Protection Design/Operations Criteria*, 12/21/01.
  - HNF-RD-7899, Rev. 1, *Fire Protection System Testing/Inspection/Maintenance/Deficiencies*, 4/11/2002.
  - HNF-PRO-052, Rev. 7, *Corrective Action Management*, 6/7/01.
  - HNF-MD-6410, Rev. 2, *Fluor Hanford Issue Management Systems*, 3/29/01.
  - Hanford Fire Department Needs Assessment and Master Plan.
  - *Fire Marshal's Charter* (via DOE Richland Office) – Correspondence No. 9957249/99-QSH-298.
  - *Fire Marshal's Charter* (via DOE Office of River Protection) – Correspondence No. 0005771/00-SHD-103.
  - Fluor Daniel Hanford, Inc. letter FDH-9756222A R2, *Response to Status Report of Current Environment, Safety and Health (ES&H) Exemptions, Waivers, Deviations, Equivalencies, and Variances*, dated December 31, 1997.

**Personnel/ Positions Interviewed:**

- Previous interview with HFD management and Fire Protection Engineers during Needs Assessment and Master Plan effort.
- Interview with Fire Marshal and HFD assigned Assistant Fire Marshals/Fire Protection Engineers related to issues management, Exemptions and Equivalencies, and relationship of Project Fire Protection Engineers.
- Interviewed Fire Protection Services Testing and Logistics Captains regarding fire systems inspection, testing, and maintenance programs.
- Interviews with Fire Protection Engineers.
- Random operations personnel at Canister Storage Building, Building 222-S, T-Plant, and 105KE questioned about basic fire safety practices and programs.

**Evolutions/Operations/Shift Performance Observed:**

None.

## **RESULTS:**

### **Discussion of Results:**

DOE Order 420.1 and 440.1A contain similar language that are intended “to establish requirements for a comprehensive fire and related hazards protection program for facilities sufficient to minimize the potential for: (1) the occurrence of a fire or related event; (2) a fire that causes an unacceptable on-site or off-site release of hazardous or radiological material that will threaten the health and safety of employees, the public or the environment; (3) vital DOE programs suffering unacceptable interruptions as a result of fire and related hazards; (4) property losses from a fire and related events exceeding defined limits established by DOE; and (5) critical process controls and safety class systems being damaged as a result of a fire and related events.” The local RLID 420.1 and supplemented CRD O420.1 both carry this intent over into contractual obligations, both directly and with expanded requirements specific to the Hanford Site.

The Fluor Hanford, Inc. contract (DE-AC06-96RL13200) recognizes these primary DOE Orders for fire protection, as well as the local Richland Office Implementing Document (RLID) 420.1. DOE, Richland Office Memorandum 02-PRO-0817 indicates an intended change in requirements from RLID 420.1 to a Richland Office-augmented version of the Contract Requirements Document (CRD) attached to DOE Order 420.1. Fluor Hanford, Inc. responded to the DOE Memorandum with Fluor Hanford Memorandum FH-0202168A.R1, which identified that FHI is essentially compliant with the supplemented CRD, with the exception of recognition in written program and procedure documents. A request for funds to perform the procedural modifications was forwarded with the FHI Memorandum.

### **Supporting Objective FP.1.1**

*Fire protection criteria are documented in a "Fire Protection Program". The Fire Protection Program document reflects, as a minimum:*

- *The Facilities and/or Areas for which the Contractor is contractually obligated.*
- *The organization and responsibilities of the fire protection staff;*
- *Administrative aspects of the Fire Protection Program; and*
- *Requirements for physical fire protection features.*

The primary document for implementation of the Fire Protection Program within Fluor Hanford is HNF-8663, Section 12. HNF-8663 is the Standards/Requirements Identification Document (S/RID) for Fluor Hanford, and includes the primary Project Areas that are included within the scope of the Fire Protection Program. They are:

- Fast Flux Test Facility
- Nuclear Material Stabilization Project
- River Corridor Project
- SNF Project
- Waste Management Project

Within HNF-8663 – which directly references RLID 420.1, DOE Orders, 29 CFR 1910, and Washington Administrative Code (WAC) requirements – is a outline of the basic requirements and responsibilities of the Fire Protection Program. This document includes all facets of fire

protection, including emergency response, prevention, hazardous materials control, engineering, and training. More specific information flows down from HNF-8663 to HNF-RD-10606, which includes specific criteria references for the Fire Protection Program. HNF-RD-10606 and HNF-8663 both refer to the Orders, Standards and Contractor Requirements Documents identified above. As well, HNF-8663 specifically includes the facilities and locations to which the requirements are applicable.

Both of these documents include specific references to:

- The organization and responsibilities of the fire protection staff;
- Administrative aspects of the Fire Protection Program; and
- Requirements for physical fire protection features.

The distribution and responsibilities of the staff are also reflected in organizational charts for the individual Project Areas. Additionally, specific procedures and requirements documents specific to the Fire Protection Program provide delineated responsibilities for particular topics, such as fire system inspection, testing, and maintenance, Fire Hazards Analyses, etc.

### **Supporting Objective FP.1.2**

*The Contractor has management commitment to the Fire Protection Program.*

Contractor organizational charts indicate that Fluor Hanford, Inc. has placed adequate emphasis on safety, from an organizational standpoint. In the Fire Department, the Chief reports directly to a Vice President, and is a fourth-level manager within the overall company. Within the various Projects, the Fire Protection Engineers report primarily through Environmental, Safety, Health, and Quality (ESH&Q) managers, who then report to Vice Presidents. The Fire Protection Engineers also, either through direct reporting or through memoranda of agreement, report through the Fire Marshal, who holds a position directly below the Chief within the HFD.

Conversations held with a variety of personnel – including the Fire Protection Engineers, Fire Marshal, DOE Facility Representatives, Facility Operations Managers, general facility workers, and other building personnel – indicate that attention to fire and life safety concerns are held in high regard. It was noted by some – mostly Facility Operations Managers and Fire Protection Engineers – that day-to-day concerns such as housekeeping, hot work program compliance, and similar facility specific programs presented challenges due to a number of factors. However, improvements were noted by the interviewees as management becomes more aware of the importance of fire and life safety, particularly relative to impacts to Authorization Basis and Fire Hazards Analysis documents. While it was noted that the various facilities were very systems-oriented, there were also indications that the administrative programs were maturing (see CRAD FP.10 for more information). As well, Facility Operations personnel and DOE Facility Representatives were knowledgeable of and following closely the current trend to coordinate the Authorization Basis and Fire Hazards Analysis documents and their comparative implementation.

One area where additional emphasis is needed is in funding of personnel and programs. Although not specifically part of this assessment, this is particularly true of the emergency response portion of the program. The Hanford Fire Department Needs Assessment provided a

recommendation to seek non-competitive funding (i.e., direct or not in competition with other capital fund projects) for, as a minimum, the centralized fire protection group (i.e., emergency response, fire protection engineers, Fire Marshal, training, and inspection, testing, and maintenance organizations, etc.). Although not directly included in the Needs Assessment itself, the Team developing that document identified that funding for the fire protection organizations varied from direct sources (primarily for emergency responders) to capital funding (for some vehicles and most structures) to Project funding (typically for the Project-assigned Fire Protection Engineers and some non-response organizations within the Fluor Hanford program). The Project funding of the Fire Protection Engineers appeared adequate and can be adjusted for additional needs as they develop through the sharing of resources between Projects or through obtaining subcontractor aid. As is always the case, needs beyond those assumed at the beginning of the fiscal year are typically identified after concerns have developed. However, this is a common problem amongst all disciplines and is not a fire protection specific concern.

In the case of programmatic management beyond the response and training organizations, the funding for the Fire Marshal's Office and the central Fire Protection Engineers has left one position open for at least six months. There does not appear to be funding for the position planned for the next fiscal year at this time. Successful programs such as the Fire Marshal's permitting system, the Fire Protection Forum web page and network server drive, and maintenance of overriding engineering and program implementation are currently at the limit of the time and budget constraints of the Fire Marshal's Office. These duties are either directly delineated via RLID 420.1, the supplemented CRD O420.1, or the Fire Marshal's Charters or are the accepted methods for implementation of performance-based requirements from those same documents.

Although a detailed budget-versus-work scope analysis was not performed, experience with such conditions indicates that there is foreseen, in the relative near future, a potential for failure in meeting the needs of the Site relative to programmatic leadership and maintenance of programmatic compliance because of these constraints. Items identified in CRAD FP.2 relative to programmatic assessments was somewhat linked, via conversations, to a lack of personnel to perform the assessment while continuing to support Hanford Site Operations activities, facility assessments, and overall programmatic functions. As well, proposals to the Fire Marshal and the lead Fire Protection Engineers for administrative programs to implement concerns raised in other areas of this assessment were generally met with resistance, which primarily cited existing workload and efforts. Overall, it appears that a near-term concern with overall programmatic oversight will arise as additional burden is either assumed by or assigned to the Fire Marshal/Fire Department and could lead to programmatic non-compliances.

Similarly, conversations with personnel related to fire system inspection, testing and maintenance indicate that marginal funding is appropriated at the beginning of each fiscal year. This leads to impacts on the implementation of various portions of that specific element become problematic when budget cuts are experienced during the fiscal year. While minimally required testing and maintenance functions are given priority, the fiscal profile generally experienced after there is a cut limits the ability of Firefighter Apprentice personnel to engage in Station duties that are required for their training to maintain Firefighter status. This has implications with respect to the assumptions made in the Hanford Fire Department Needs Assessment that use the Testing and Logistics firefighters for large fire and medical events, such as wildland fires or mass casualty incidents. Such limitations could cause failures in implementing required testing

and maintenance of systems should the current funding scheme continue. Beyond the obvious DOE Order infractions, continued operability of the fire systems is an intrinsic assumption of the Needs Assessment that is used in determining the baseline personnel needed for fire response and accounting for equivalency to NFPA 1710. Infringement on the inspection, testing, and maintenance programs for fire systems would require revisiting the Needs Assessment document and could considerably change the baseline needs. As well, a noticeable shift is apparent in the DOE Richland Office regarding the crediting of fire protection systems in Authorization Basis document, where no credit is currently assigned. As with the Needs Assessment, failure to perform the requested duties within the inspection, testing, and maintenance organization could have considerable impact to a facility's ability to operate without incident.

There is some compromise in services provided outside the normal scope of established testing and maintenance. The Needs Assessment Team was requested to investigate changes in the work schedule of the two inspection, testing, and maintenance teams to determine if customer concerns could be addressed. The noted concerns regarding timeliness and/or number of support personnel were not tied to the schedule of the personnel so much as they were to limitations in the number of personnel to perform the requested work. Budgetary cuts did not allow for two-person teams when needed or overtime when desired. Experience of other Sites – Rocky Flats and Mound, in particular – indicate that the need for such services will rise over time due to the combined construction and D&D mission of the Site. Overall, if the existing funding situation is maintained, customer concerns will continue to rise and further impacts to the Needs Assessment could be experienced.

### **Supporting Objective FP.1.3**

*The Contractor has a policy statement that implements DOE fire protection related mandatory Orders, codes and standards.*

DOE Order 420.1 provides a requirement that the Fire Protection Program have:

*A policy statement that incorporates the requirements of this Section [Section 4.2.1], related DOE directives, and other applicable Federal, state and local fire protection requirements. The statement shall affirm management's commitment to support a level of fire protection and fire suppression capability sufficient to minimize losses from fire and related hazards consistent with the best class of protected property in private industry.*

Fluor Hanford has no specific policy statement regarding fire protection. However, Fluor does have an overriding policy for all safety related disciplines in HNF-5053, *Policy for Environment, Safety, and Health*. This policy identifies a commitment to all safety and health disciplines and the Integrated Safety Management System (ISMS).

HNF-8663, Section 12 specifically contains a policy statement for the nuclear facilities managed by Fluor Hanford, Inc. regarding fire protection. Section 12.2 includes policy statements that reflect the overriding requirements identified in DOE Order 420.1 and the locally augmented requirements (i.e., RLID 420.1 and/or supplemented CRD O420.1). The wording of the policy is taken directly from the DOE Orders and the *Implementation Guide for DOE Orders 420.1 and 440.1: Fire Safety Program*.

#### **Supporting Objective FP.1.4**

*The Contractor has a method of requesting and tracking Exemptions and equivalencies to DOE fire protection related mandatory Orders, codes and standards.*

DOE Order 420.1, Section 4.2.1.11 indicates that an element of the Fire Protection Program is:

*A process for reviewing and recommending approval of fire safety 'equivalencies' and 'exemptions' to the DOE Authority Having Jurisdiction for fire safety.*

Fluor Hanford, Inc. has a process to prepare and submit Exemption, Equivalencies, and Deviations as described in HNF-8663, Section 12.8 and HNF-RD-9188. A listing of Exemptions, Equivalencies, and Deviations are contained in Section 12.8.1 of HNF-8663.

This document represents the only formalized listing of Exemptions, Equivalencies, and Deviations. While it is recognized that, through its correspondence files, the DOE Richland Office could likely retrieve any identified memorandum or letter, there is not a current formalized list of the specific Exemptions, Equivalencies, or Deviations that have been granted. Therefore, no comparative evaluation was performed with those held by the Department of Energy and those held by FHI.

Continued discussion regarding this concern with DOE Richland Office personnel indicated that there were potential questions regarding the carry-over of previously granted Exemptions, Equivalencies, and Deviations from one contract to another. As an example, it could not be determined if Exemptions granted to Westinghouse under a previous contract could be carried over to Fluor Hanford without specific contractual language indicating such. Also, it was not evident that "Sitewide" Exemptions or Equivalencies granted to Fluor Hanford – for example for testing of fire suppression systems – could be applied to other contractors such as Bechtel National or CH2M Hill Hanford Company. As this is currently common practice, it is an assumed default. However, the implications regarding this issue warrant a review of the question by DOE Richland Office. As well, the implications carry, to some extent, to DOE Office of River Protection and warrant review by that office also.

Another combined Contactor-DOE related concern is the issue of change or cancellation of Exemptions, Equivalencies, or Deviations. Because Exemptions and Equivalencies in particular are considered contractual obligations, by extension of the existing contract and the DOE Orders specified, their continued application is expected unless cancellation is somehow identified. At a number of other DOE Sites, the method of cancellation is the same as the original request – a request is made and must be granted by the local DOE Office, as a minimum. There are a number of Exemptions and Equivalencies that representatives of the Fire Marshal's Office indicated are obsolete or have been overridden by other evaluations or Exemption/Equivalency requests. This results in a confusing situation regarding determination of what issues are applicable. As well, it also raises questions as to whether or not all Exemptions/Equivalencies are applicable. Following the assumption that all of the Exemptions/Equivalencies are, in fact, applicable, this places Fluor Hanford in varying degrees of non-compliance depending on the scope of the Exemptions/Equivalencies that are assumed to be obsolete, closed, or overridden.

Deviations carry a slightly different concern, in that Deviations are in-house modifications to existing programs and processes within Fluor Hanford, Inc. Deviations are tracked in several different locations, depending on the procedure or program for which the Deviation is granted. Two specific examples are the Fire Marshal's Permit web-site on the Hanford intranet and variances granted against procedure HNF-PRO-7899, which are also included on the Hanford intranet. The Fire Marshal's Permit web-site contains the permits themselves, including the specified conditions or controls for the Permit. A random review of permits indicates that no variances to required codes and standards were allowed unless they were within the flexibility provided by the code or standard that was being applied. There is a danger, however, that situations that constitute an Exemption or Equivalency could be inadvertently addressed via this system without the proper follow-through with the DOE Richland Office. As well, there is also a danger, based on the information in CRAD FP.10 that any associated compensatory measures or administrative controls could be "lost" in the system and not continuously addressed by the facilities.

The variances granted to HNF-PRO-7899, however, do make modifications to codes and standards requirements that would normally constitute an Exemption or Equivalency. As an example, variance HNF-RD-7899-var2 alleviates the Fast Flux Test Facility from implementation of NFPA 25 testing and maintenance frequencies and defaults to the previous implementation document (which covered previous NFPA standards that became feed documents for NFPA 25), FSP-FFTF-FP-4-41, Rev. 0, dated 6-22-98. The decision to implement or not implement NFPA 25 is generally not within the responsibility of the Contractor, but with the cognizant DOE representative. As well, a number of the variances change the requirements for testing and maintenance of fire barriers and their components. Although these are "interpreted" requirements within HNF-PRO-7899, their tie to an NFPA document gives the impression that an Exemption or Equivalency would be the expected level of response to the issue. As a minimum, a clarification should be developed between Fluor Hanford and DOE Richland Office as to the allowable scope under which such variances can be granted.

Discussions with Fire Marshal's Office personnel indicates that the only master file of Exemptions/Equivalencies/Deviations exist within that Office. The file is maintained by the Fire Protection Engineers assigned to the Office. Additionally, a common folder on the computer network acts as a repository for electronic versions of the Exemptions/Equivalencies/Deviations for use by the Project Fire Protection Engineers. There is not, however, a master list of documents nor a cross-walk document that would indicate which documents are applicable to specific facilities or operations. The discussions with the Fire Marshal's Office personnel indicated that there have been additional Exemptions, Equivalencies, or Deviations granted since the publication of the S/RID that have not been included in that document, but are to be included at the next update, which is required to occur annually.

These conversations, as well as those held with Project Fire Protection Engineers, revealed that there was not a feeling of confidence that the provisions of the Exemptions, Equivalencies, and Deviations (i.e., administrative controls, compensatory measures, etc.) were well known to personnel in general, or that the provisions were being identified or implemented in facility specific documents (i.e., Fire Hazards Analyses, administrative control documents, testing procedures, etc.). More information on this topic is included in CRAD FP.10. The essence of the review, however, is that the linkage of administrative controls to Exemptions, Equivalencies,

and Deviations is somewhat lost due to the method of controlling and tracking the origin documents.

Additionally, discussions with the Project Fire Protection Engineers demonstrated that they were cognizant of some of the allowances given by the Exemptions, Equivalencies, and Deviations, but were not sure of the source or the implications of failing to meet the requirements. This topic is discussed in more detail in CRAD FP.10 specifically relative to administrative controls and compensatory measures, however similar concerns permeate into the overall implementation of the Exemption/Equivalency/Deviation process.

### **Supporting Objective FP.1.5**

*The Contractor has a process for identifying, tracking, and resolving recommendations and/or findings resulting from internal and external assessments.*

Fluor Hanford uses Sitewide processes and procedures in order to track deficiencies and concerns developed both internally and externally. Existing fire protection procedures reference HNF-PRO-052, and indirectly HNF-MD-6410, or identify, track, and develop corrective actions for concerns relative to the Fire Protection Program. Issues source documents range from external evaluations to internal assessments to Fire Hazards Analyses, as well as a plethora of other documents.

Several of these document sources were evaluated, with a recognized limitation based on timing. Conversations with Project Fire Protection Engineers and Fire Marshal's Office staff indicated that there has been little to no attempt to bring previous deficiencies or recommendations prior to a certain date (which appears to be approximately January 2000, based on very little information garnered from commitments tracking reports) up to date. This means that existing Fire Hazards Analysis recommendations, in particular, may not be collected in the various Site deficiency databases. The FHA recommendations are carried forward into the new documents and then entered when revisions occur, however there appears to be no specific effort to bring these recommendations into the tracking systems if no update is made.

Beyond the Fire Hazards Analyses, there appears to be very good use of the Site tracking systems for corrective actions management. From an external issues standpoint, several externally generated reports were reviewed and verified that the recommendations were being appropriately tracked, as well as being addressed by Fluor Hanford.

Three external assessment documents - primarily in the field of emergency management, but having components that affect many aspects of the Fire Protection Program - were used to evaluate external commitments. The three documents were:

- *U.S. Department of Energy Response to the 24 Command Wildland Fire on the Hanford Site - June 27 - July 1, 2000*, DOE/RL-2000-63, October 2000.
- *Comprehensive Fire Safety Review: The Hanford Site*, October 2001.
- *Initial Joint Review of Wildland Fire Safety at DOE Sites*, December 2000.

The recommendations contained within each of these documents was verified through the HFD to have been entered into a commitments tracking systems, addressed, and appropriately

dispositioned. It should be noted that this effort was performed by the Hanford Fire Department Needs Assessment Team, and the dispositions were evaluated in depth as well as the actual management system. In both the administrative and actual action perspectives, adequate implementation was found (although recommendations for specific actions are contained within the Needs Assessment document).

From an internal standpoint, the Fire Marshal and two Project Fire Protection Engineers (Waste Management Project and River Corridor Project) were able to demonstrate that internal commitments, such as those arising from Fire Hazards Analyses, self-assessments or Facility Evaluation Board evaluations, were included in one of the Sites commitments tracking systems and addressed, using the same systems to show closure information and documentation.

**Conclusion:**

With some minor exceptions, Fluor Hanford, Inc.'s Fire Protection Program meets or exceeds the minimum expectations and requirements of the DOE Orders and local supplemental documents (i.e., RLID 420.1 and supplemented CRD O420.1). The Program is well documented in Project Hanford Management System documents and there is coordination between the Fire Protection and Site organizational documents. Site programs are used to achieve certain aspects of the program, which eliminates any inconsistencies with Site policies and efforts. The Fire Protection Program elements are well reflected in the Site-level documents, indicating both a recognition and support for the Program.

Support for the program is also clearly demonstrated by the attitudes and knowledge of personnel ranging from the Fire Chief to facility Health Physics Technicians. Random interviews indicated that a consistent message and clear understanding was evident.

One point of concern noted in the realm of continued support within Fluor Hanford was continued recognition of Fire Protection Programs, the minimum requirements expectations, and the impacts of current funding practices. This issue was raised by the Hanford Fire Department Needs Assessment, and additional information included herein indicates that attention by Fluor Hanford is warranted. While it is recognized that no detailed budgetary evaluation was performed under this effort, the consistent message of potential budgetary shortfalls impacting both programmatic and emergency response capabilities is an indicator that the current system of marginal funding and subsequent budget cuts does not appropriately support the overall fire protection needs of the Site.

Concerns regarding the overall tracking, usage, and continued maintenance of Exemptions, Equivalencies, and Deviations indicates a need for better control over the entire system. At present, a master hard-copy file is the only comprehensive repository and catalogue of such documents, both for Fluor Hanford, Inc. and for DOE Richland Office – and it is possible that even this file may not be complete. Because of this, there are a number of concerns that arise, ranging from implementation of administrative controls to maintenance of such controls and other conditions identified within the documents to the applicability of Sitewide requests to contractors outside Fluor Hanford (particularly those under the DOE Office of River Protection) to recognition that the documents represent legal commitments to DOE Richland Office and the requisite issues with failure to comply with any conditions identified. While it is recognized that the process of requesting, implementing, and maintaining these documents is a minor portion of the overall Fire Protection Program, the inability to truly track minimum requirements not only

can lead to programmatic non-compliances, but can result in fire risks well in excess of those expected or accepted by the DOE Richland Office.

A minor issue was also noted with the tracking of older Fire Hazards Analysis recommendations that have not yet been closed or addressed. These outstanding issues should be raised and included in Fluor Hanford deficiency identification and commitments tracking data systems to ensure that the concerns are given the necessary attention for correction or appropriate disposition. Refer to CRAD FP.6.

**Issues:**

- Overall, the Fire Protection Program is well documented, with assigned roles and responsibilities well defined and known.
- Fluor Hanford, Inc. places a high priority on fire safety on the Site, through appropriate organizational structure, attention to Fire Protection Programs, and demonstration of basic fire safety practices and methods by all levels of personnel.
- There is concern regarding funding for continued capability of the centralized fire protection organizations – primarily the emergency response, Fire Marshal's Office, and inspection, testing, and maintenance teams – to continue with the high level of service currently provided given the known increasing programmatic expectations and change in mission. Continuing current funding practices is expected to limit acknowledged noteworthy practices (such as the Fire Marshal's permitting process), impact programmatic implementation of DOE mandated programs (such as self-assessments), and challenge basic assumptions of emergency response capabilities (see the Hanford Fire Department Needs Assessment).
- While recommendations and deficiencies from Fire Hazards Analysis documents are entered into commitments tracking systems as they are created or updated, previous recommendations (generated previous to approximately January 2000) that have not yet been addressed have not been entered into any such tracking systems.
- There are a number of concerns regarding Exemptions, Equivalencies, and Deviations:

**Fluor Hanford, Inc.**

- While there is a process for requesting Exemptions, Equivalencies, and Deviations contained in HNF-8663, there is no method for maintenance, revision, or cancellation of the documents.
- The Hanford Fire Marshal's Office holds the current master file of Exemptions, Equivalencies, and Deviations. While there is a general acknowledgement that this is likely the most complete compilation of such documents, there are few who have a comprehensive knowledge of the issues, controls, and applicability of the documents. No method is currently present to provide a clear understanding of which Exemptions, Equivalencies, or Deviations are applicable to a given facility or program element, what the specific controls are (if any), and if the document is still current under consideration of contractual, facility, or conditional changes.
- The current method for granting deviations or variances to Fluor Hanford processes and procedures raises questions regarding the limits of authority of the Fire Marshal, as opposed to the DOE Richland Office, in allowing modifications to application of national codes and standards. A clear line of authority needs to be developed consistent with DOE Order requirements.

- The linkages and flow of administrative controls from Exemptions, Equivalencies and Deviations to facility level control documents is not well defined. See CRAD FP.10 for more information.

**DOE Richland Office**

- There is no comprehensive up to date list within the DOE Richland Office that would allow one to easily determine the Exemptions, Equivalencies, or Deviations granted by the Office.
- The change from a single Management and Operating (M&O) contractor to the current scheme raises an issue as to whether or not “Sitewide” Exemptions, Equivalencies, or Deviations granted to Fluor Hanford (such as those for the inspection, testing, and maintenance of fire systems) can be applied to other Site contractors, such as CH2M Hill Hanford Company and Bechtel National.

## **Self Assessments**

### **Objective FP.2 – Self-Assessments**

Programmatic self-assessments are performed as specified in RLID 420.1, Section 6.2e and 8.10 [CRD Supplemental 420.1, Section B 4]

**Supporting Objective FP.2.1.** Documented self-assessments are performed at least every three years for:

- Facilities valued between \$1 million and \$100 million;
- Non-nuclear facilities considered to be a high or moderate hazard, as defined by DOE 5481.1B;
- Category 1, 2, or 3 nuclear facilities as defined by DOE 5480.23

**Supporting Objective FP.2.2.** Facilities less than \$1 million are assessed at least every three years with a smaller scope. See RLID 420.1, Section 6.2 e(3) [CRD Supplemental 420.1, Section B 4]

**Supporting Objective FP.2.3.** Comprehensive assessments of Fire Protection Program elements shall be made every three years.

#### **Criteria:**

The Contractor has a process for performing self-assessments as specified in RLID 420.1, Section 6.2 e(4) [CRD Supplemental 420.1, Section B 4].

1. The Contractor can demonstrate that facilities under its jurisdiction have had at least one self-assessment performed.
2. Self-assessments are performed on the frequencies noted in the Supporting Objectives.
3. Copies of the last two self-assessments are kept on file by the Contractor.

#### **Approach:**

1. Validate, via interview or by document review, that the Contractor has a process for performing facility self-assessments. A documented plan is preferred.
2. Determine if the Contractor has a schedule for the facility self-assessments. Compare the schedule to the list of buildings to which the Contractor is contractually obligated to ensure that all facilities are accounted for. Ensure that the frequency for the facility self-assessments match the frequencies specified in Supporting Objectives FP.2.1, FP.2.2, and FP.2.3.
3. Obtain copies of several (as specified by the team lead) facility self-assessments. Review the self-assessments to determine if the content is as desired by the facility-related sections of this assessment. Ensure that the current and one prior assessment (if the self-assessment is not the first revision to be issued) are on file and available from the Contractor.
4. Validate, via interview or by document review, that the Contractor has a process for performing programmatic self-assessments. A documented plan is preferred.

5. Obtain copies of programmatic self-assessments (program elements as specified by the team lead) performed by the Contractor. Review the self-assessment to ensure that the expectations of RLID 420.1 [CRD 420.1 Supplemental] are incorporated into the assessment and that adequate treatment has been provided for each area under review. Ensure that the current and one prior assessment (if the self-assessment is not the first revision to be issued) are on file and available from the Contractor.

**Basis:**

Department of Energy policy currently places much of the responsibility for continued maintenance of Fire Protection Programs on the operating contractors. As such, a program of self-assessment is necessary to ensure that the Contractor not only establishes, but also internally maintains, the level of fire protection as obligated via contractual means. Determining the schedule, scope, and continued practice regarding self-assessments to achieve this goal indicates that the Contractor continually re-validates its program with respect to trends and expectations within the DOE complex.

**References**

DOE O 420.1, Contract Requirements Document, Section 4.2.1.9  
RLID 420.1, Section 8.10  
[CRD Supplemental 420.1, Section B 4]

**Interviews:**

Not applicable.

**Observations:**

Not applicable.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August 2001.
- Project Hanford Management Contractor Documents:
  - HNF-RD-10606, Rev 0: Fire Protection Program Requirements, April 29, 2002.
  - HNF-RD-9391, Rev 0: Fire Protection Assessments Rev. 0, March 28, 2002.
  - HNF-SD-HT-FHA-002, Rev. 1.
- Program and Facility Fire Protection Assessments
  - Fluor Daniel Hanford, Inc. Memorandum FDH-9852665, PHMC Fire Protection Program Integration Review, March 30, 1998.
  - Fire Protection Assessment, Building 324, March 2001.
  - Fire Protection Assessment, Building 324D, April 2001.

- Fire Protection Assessment, Building 225-B, December 1, 2000.
- Fire Protection Assessment, Building 242-A, September 2001.
- A-6003-247, Facility Fire Protection Assessment – Long Format.
- A-6003-248, Facility Fire Protection Assessment – Short Format.
- Facility Evaluation Board Assessment Report, FEB-FY01-06.
- Facility Evaluation Board Assessment Report, FEB-FY02-02.
- Facility Evaluation Board Assessment Report, FEB-FY02-01.
- Other Facility Documents
  - Letter, NC Boyter to PM Knollmeyer, “Contract No. DE-AC06-96RL13200 – 324 Building Fire Hazards Related Exemption and Equivalencies”, FH-9957327 R5, dated April 27, 2000.
  - Letter, PM Knollmeyer to RD Hanson, “Contract No. DE-AC06-96RL13200 – Approval of 324 Building Fire Hazards Analysis and Associated Implementation Plan Resubmittal and Related Exemption and Equivalencies”, 00-FTD-060, dated May 30, 2000.
  - River Corridor Project Fire Protection Program, RCP-PRO-019, Rev. 2, effective date August 21, 2001.

**Personnel/ Positions Interviewed:**

Fluor Hanford Fire Marshal

Fire Protection Engineers (Contractor)

Fire Protection Engineers (Fire Marshals Office)

**Evolutions/Operations/Shift Performance Observed:**

None.

**RESULTS:**

**Discussion of Results:**

**Supporting Objective FP.2.1**

*Documented self-assessments are performed at least every three years for:*

- *Facilities valued between \$1 million and \$100 million;*
- *Non-nuclear facilities considered to be a high or moderate hazard, as defined by DOE 5481.1B;*
- *Category 1, 2, or 3 nuclear facilities as defined by DOE 5480.23*

**Supporting Objective FP.2.2**

*Facilities less than \$1 million are assessed at least every three years with a smaller scope. See RLID 420.1, Section 6.2 e(3) [CRD Supplemental 420.1, Section B 4]*

Fluor Hanford has a process for performing facility self-assessments as specified in RLID 420.1. The following documents have been reviewed and contain requirements for the conduct of facility self-assessments:

- HNF-RD-10606, Rev 0, *Fire Protection Program Requirements*, April 29, 2002, provides an overview of the Project Hanford Management Contract (PHMC) Fire Protection program requirements. Section 2.4.4.d requires PHMC Project Management to assist fire protection personnel with fire protection facility assessments.
- HNF-RD-9391, Rev 0, *Fire Protection Assessments*, March 28, 2002, provides the frequencies and requirements for fire protection facility and program assessments for facilities and programs under the PHMC.
- RCP-PRO-019, Rev. 2, *River Corridor Project Fire Protection Program*, August 21, 2001 - Section 4.3.7 requires the RCP ESH&Q Fire Protection Engineers to establish and maintain a list of those facilities/buildings that require fire protection facility assessments, and ensure new facilities are added to the list. Section 4.3.8 requires the performance of fire protection facility assessments.

Schedules for facility assessments have been obtained for Hanford Site Operations (HSO), River Corridor Project (RCP), Spent Nuclear Fuels (SNF), and Waste Management Project (WMP) facilities. The scheduled frequencies of the assessments correspond to the required frequencies of the referenced requirements documents. There were several facilities on the lists that were beyond their due date. Interviews with the responsible Fire Protection Engineers indicate that these facilities were recently transferred to Fluor Hanford responsibility.

Fire Protection Assessments of the K-Basins (105 KE and 105 KW) were last performed in December 1997. Interviews with Fire Protection Engineers indicate that credit for the conduct of further self-assessments (2002) of these facilities was assumed based on approval of the Fire Hazard Analyses (approved in early 2000). However, the requirement for facility self-assessments is not obviated by the preparation of FHA's. RLID 420.1, Section 8.10 states:

*"To the extent that required elements for a facility assessment are adequately covered by either a facility fire hazards analysis or another assessment (within the relative same time period) a reference to the applicable fire hazard analysis section or assessment is considered adequate to satisfy that assessment element."*

The Fire Hazards Analyses do not specifically address all elements required to be evaluated in a facility fire protection assessment. The following elements are not addressed or are only partially addressed in the FHA's:

- Fire fighting water runoff.
- Prefire/action plans.
- Fire apparatus accessibility.
- Completeness of Fire Hazards Analyses.
- Fire barrier integrity (cited if they are present, but do not evaluate).
- Facility specific training relative to fire safety.
- Review and maintenance of the facility Fire Hazards Analysis (required only for nuclear facilities).
- Inspection, testing, and maintenance reports.

The facility assessments reviewed substantially address the facility-related elements of RLID 420.1; Section 8.10 b. The following element does not appear to be fully addressed:

- The fire protection assessments do not adequately review the implementation of administrative controls in the facilities or temporary protection and compensatory measures. Although “Administrative Controls” are addressed in the assessments, approved Exemptions or Equivalencies are not specifically mentioned. The requirements stipulated as a result of Exemption Request administrative controls do not appear to have been specifically included in the assessment. For example, the Building 324 FPA, page 6, Loss Prevention Programs (Item 2) states that the fire protection systems in Building 324 are tested in accordance with HNF-PRO-7899. The exemption/equivalency request for a 3-hour Fire Barrier in the building due to the MPFL requires weekly checks of sprinkler control valves (instead of monthly). DOE-RL directed FHI to implement the administrative controls necessary to manage the MPFL below \$1 million. This increased frequency for the sprinkler control valve verification was not specifically addressed in the facility assessment report.

None of the assessment reports reviewed specifically mentions Exemptions or Equivalencies when addressing administrative controls (see CRADs FP.1 and FP.10 for more information). Also, it is not explicitly obvious whether facility Fire Hazards Analyses are being reviewed to identify any administrative controls referenced in the analysis (see CRADs FP.4, FP.6 and FP.10 for more information). Assessment of these activities is essential in cases where reliance is placed on administrative controls to manage fire risk within a facility.

### **Supporting Objective FP.2.3**

*Comprehensive assessments of Fire Protection Program elements shall be made every three years.*

Fire protection program assessments are not performed on a periodic basis as required by RLID 420.1 and HNF-RD-9391. Self-assessments of the Fire Protection Program are required to be conducted every three years. Only one program assessment, conducted in 1998, was obtained (FDH-9852665, PHMC Fire Protection Program Integration Review). The assessment did not address all elements of the Fire Protection Program as identified in RLID 420.1; Sections 8.10 (a) and (c) as required by HNF-RD-9391, Section 2.2. The assessment addressed the following elements of the Fire Protection Program. These included having links in place to the Project Hanford Management System (PHMS) Fire Protection Procedures:

- The performance of self-assessments such as fire protection facility assessments and Standards & Requirements Identification Document (SRID) assessments;
- Involvement in the review of documents that may affect fire protection to ensure hazards are mitigated and compliance is achieved with applicable requirements; and
- The use of a tracking system for findings/recommendations resulting from assessments.

RLID 420.1; Sections 8.10 (a) and (c) require the following elements to be addressed:

(a) Program-related:

- Comprehensiveness of the Fire Protection Program.
- Procedures for engineering design and review.

- Procedures and personnel for maintenance, testing, and inspection.
- Fire protection engineering staff (number, qualifications, training).
- Fire suppression organization (personnel and training).
- Fire suppression mutual aid agreements.
- Management support.
- Exemptions and documented equivalencies.

(c) Combined Aspects (Program & Facility)

- Inspection, testing, and maintenance reports.
- Adequacy of facility appraisal/assessment reports.
- Tests of fire suppression systems, water supplies, and procedures for maintaining these in working order.
- Administrative controls.
- Temporary protection and compensatory measures.
- Status of findings from previous assessments.
- Conformance with applicable Orders, codes, and standards.
- Findings, observations, or recommendations that are required to be corrected to meet the fire protection objectives.

The following completed or in progress assessment activities address some of the program elements listed above:

1. A Fire Department Baseline Needs Assessment has been prepared in accordance with RLID 420.1, Section 6.4 (o). The needs assessment thoroughly evaluates the emergency services organization, apparatus, communications, pre-planning, emergency response, training, and other pertinent areas of providing emergency services. The needs assessment is required to be updated on a minimum five-year basis. The current update was completed in June 2002.
2. A Value Engineering Study Report of the Fire Protection Engineering resources at the Hanford Site was issued in January 1999. The purpose of the study was to develop a recommended model that assures DOE compliance and optimizes effective and efficient use of Site Fire Protection Engineering resources.
3. An assessment of the fire protection impairment program element is currently being performed and is scheduled for completion in June 2002. A final report was not available at the time of this evaluation.

**Conclusion:**

Fluor Hanford Fire Protection Engineers perform facility assessments as required by HNF-RD-9391, *Fire Protection Assessments*. A more rigorous review of administrative controls contained in facility Fire Hazards Analyses should be conducted during the facility assessments.

Fire protection program assessments are not performed on the periodic basis as required in RLID 420.1 and HNF-RD-9391. Some elements of the Fire Protection Program (fire suppression organization personnel and training; fire suppression mutual aid agreements; and fire protection engineering staff) have been reviewed. However, the Fire Protection Program will benefit by a more rigorous self-assessment program as required by HNF-RD-9391.

**Issues:**

1. Fire protection program assessments are not performed on a periodic basis as required in RLID 420.1 and HNF-RD-9391.
2. Administrative controls contained in facility Fire Hazards Analyses do not appear to be adequately addressed in facility fire protection assessments (see FP4).
3. The 105 KE/KW fire protection facility assessment is over due. The last facility assessment for 105KW/KE was completed in December 1997 and the FHA was last updated in January 2002. While the FHA addresses some of the facility assessment elements and the information used in the FHA may be referenced in the facility assessment, a documented facility assessment needs to be completed.

## **Fire Protection Engineering**

### **Objective FP.3 – Fire Protection Engineering**

The Contractor has adequate fire protection engineering.

**Supporting Objective FP.3.1.** The Contractor has an adequate number of fire protection engineers and/or technicians.

**Supporting Objective FP.3.2.** Contractor fire protection engineers and/or technicians are qualified for the work being performed.

**Supporting Objective FP.3.3.** Contractor fire protection engineers and/or technicians are provided Site required training.

**Supporting Objective FP.3.4.** Contractor fire protection engineers and/or technicians are provided opportunity for continued professional development via Contractor programs.

**Supporting Objective FP.3.5.** The Contractor has procedures to control engineering design and review of fire protection systems and equipment and conditions that impact fire protection, including specialized hazards, within Facilities and Areas of contractual obligation.

#### **Criteria:**

1. The Contractor employs an adequate number of fire protection engineers and/or technicians to accommodate timely resolution of fire protection engineering concerns at Facilities and Areas under contractual obligation.
2. The Contractor provides Site required training to fire protection engineers and/or technicians, and such personnel meet current training requirements.
3. The Contractor provides a method to obtain continued professional development training for fire protection engineers and/or technicians.
4. Contractor engineering disciplines ensure that the requirements of the Fire Protection Program are incorporated into new construction. Additionally, configuration control procedures are present and followed for existing fire protection systems and equipment.
5. The Contractor's engineering and maintenance divisions are knowledgeable in determining if or when fire protection engineering services are required on items not directly involving fire protection systems or equipment.

#### **Approach:**

1. Obtain a copy of the Contractor's self-assessment of the fire protection engineering element of the Fire Protection Program. Ensure the program defines the needs for fire protection engineers and/or technicians, both present and future based on contractual obligations. Validate that the current needs are met via existing staff and that future needs will be met accordingly. If a self-assessment does not exist, then validate the needs and staffing based on professional judgment and experience.

2. Review, via documentation or interview, the qualifications of all fire protection engineers and/or technicians. Interview individual fire protection engineers and/or technicians to determine their level of knowledge compared to the work they are asked to perform. Determine, based on professional judgment, if each individual is qualified to perform the tasks assigned on a daily basis.
3. Request and review current Site training records on fire protection engineers and/or technicians. Validate that all Site training is current. If not current, determine if the lack in training directly impacts the engineer's or technician's ability to complete assigned tasks.
4. Interview Contractor personnel, preferably both engineers/technicians and management personnel, regarding the mechanisms and paths for obtaining professional development training. Determine, based on professional judgment, whether adequate opportunity is being provided by the Contractor for professional development. Do not base judgment on the lack of available classes or lecture, but the willingness of the Contractor to provide time, funding, or compensation.
5. Review current or near-future large-scale engineering projects with the Contractor engineering and Fire Protection Programs to determine the level of involvement of fire protection personnel in the project. Determine, based on professional judgment, whether the level of effort being requested of and given by the fire protection personnel is commensurate with the scope and scale of the project to meet Fire Protection Program intents. Particular attention should be given to projects involving special hazards or conditions that are not directly addressed by DOE Orders, codes and standards.
6. Review existing Contractor configuration control management documents to determine if fire protection systems are adequately controlled via those processes. Also, review with maintenance personnel their process for completing work to determine if any loss of control regarding fire systems is present. Referencing existing assessments by other organizations is an acceptable method of completing this element.
7. Interview fire protection engineers/technicians, as well as engineers/technicians, regarding near-past and current projects in which fire protection concerns, outside of fire protection systems and equipment, are involved. Request non-fire protection engineers to provide current projects (the number is at the discretion of the team lead) for which they indicate that no fire protection is involved. Review the project(s) to determine if fire protection engineering personnel should have been involved.

**Basis:**

Since the 1960's, fire protection engineering has been a point of concern at Department of Energy Sites. Questions of having enough capable engineers or technicians, obtaining and maintaining their qualifications, and determining when involvement of those professionals is necessary, have been raised in various forms even in the recent past. This Objective assists the evaluator in determining if the Contractor is providing adequate engineering and safety resources for their projects.

**References:**

DOE O 420.1, Contract Requirements Document, Sections 4.2.1 and 4.2.2  
RLID 420.1, Section 5.2 u  
RLID 420.1, Section 6.2 i  
RLID 420.1, Section 6.2 l  
RLID 420.1, Section 6.2 m  
RLID 420.1, Section 6.2 n  
[CRD Supplemental 420.1, Sections 1G and B 2]

**Interviews:**

Perform interviews with Fluor Hanford personnel, as needed, to determine health and implementation of the program. Interviewees include, but are not limited to:

- HFD Fire Marshal
- Fire Protection Engineers
- DOE Facility Representatives

**Observations:**

Perform surveys of facilities to obtain a general sense of program implementation.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August, 2001.
  - *Comprehensive Fire Safety Review: The Hanford Site*, October 2001.
- Site Wide Documents:
  - HNF-PRO-1819, Rev. 7, *PHMC Engineering Requirements*, 11/06/01.
  - HNF-8002, Rev. 2, *Engineering, Procurement, and Construction Process Management Plan*, 01/14/02.
  - HNF-RD-9118, Rev. 0, *Fire Protection Design/Operations Criteria*, 12/21/01.
  - HNF- RD-9717, Rev. 1, *Fire Prevention for Construction/Occupancy/Demolition Activities*, 4/29/02.
  - HNF-PRO-1997, Rev. 5, *Project Management for Construction – Overview*, 10/16/01.
  - HNF-PRO-1999, Rev. 2, *Project Management for Construction - Conceptual Phase*, 06/15/00.
  - HNF-PRO-2000, Rev. 2, *Project Management for Construction - Execution Phase*, 10/16/01.
  - HNF-PRO-2001, Rev. 1, *Facility Modification Package Process*, 11/06/01.
  - HNF-RD-8589, Rev. 1, *Hanford Fire Marshal Permits*, 3/21/02.
  - HNF-RD-8635, Rev. 1, *Review of Technical Documents*, 06/14/02.
- Contractor Documents:
  - Résumés for Fire Marshal and Fire Protection Engineers within the Fluor Hanford, Inc. projects.

- Hanford Fire Department Needs Assessment and Master Plan.
  - Training and qualifications records for Fire Protection Engineers (during Hanford Fire Department Needs Assessment and Master Plan).
  - Hanford Fire Marshal Permit System (electronic, web-based at <http://apweb02.rl.gov/firepermit/index.cfm>).
  - Fire Marshal's Charter (via DOE Richland Office) – Correspondence No. 9957249/99-QSH-298.
  - Fire Marshal's Charter (via DOE Office of River Protection) – Correspondence No. 0005771/00-SHD-103.
  - Hanford Site Fire Protection Engineering Value Engineering Study Volumes I and II, January 8, 1999.
- DNFSB Documents:
    - *Fire Protection At Defense Nuclear Facilities*, DNFSB/TECH-27, June 2000.
    - *Safety Review Of The Hanford Spent Nuclear Fuel Project During The Design And Construction Phase*, DNFSB/TECH-30, February 2001.

**Personnel/ Positions Interviewed:**

HFD management and Project Fire Protection Engineers regarding training and qualifications during Hanford Fire Department Needs Assessment development  
HFD Fire Marshal and Fire Department Engineers  
Project Fire Protection Engineers

**Evolutions/Operations/Shift Performance Observed:**

Not applicable.

**RESULTS:**

**Discussion of Results:**

DOE Order 420.1 specifies the need for engineering capabilities to support a variety of Fire Protection Programs. Specifically, Section 4.2.1 of the Order indicates that the Fire Protection Program include:

- A system to ensure that the requirements of the DOE Fire Protection Program are documented and incorporated in the plans and specifications for all new facilities and for significant modifications of existing facilities. This includes a documented review by a qualified fire protection engineer of plans, specifications, procedures, and acceptance tests.
- Access to a qualified and trained fire protection staff, including a fire protection engineer(s), technicians and fire fighting personnel to implement the requirements...

Additionally, Section 4.2.2 provides specific design requirement expectations that necessitate the use of engineering personnel that are proficient, or at the very least familiar, with engineering design of fire protection systems and operations. Further, the DOE Order specifies the requirements that "DOE facilities, sites and activities (including design and construction) shall be characterized by a level of fire protection that is sufficient to fulfill the requirements of the best protected class of industrial risks ('Highly Protected Risk' or 'Improved Risk') and shall be

provided protection to achieve ‘defense-in-depth.’” DOE Order 440.1A contains similar language regarding Fire Protection Programs.

RLID 420.1, as well as the new supplemented CRD O420.1, echoes the requirements of DOE Order 420.1. The following requirements are also identified:

- Each prime contractor and subcontractor shall have on staff at least one qualified Fire Protection Engineer as defined by this Directive. Additional qualified fire protection engineers and fire protection staff shall be provided as necessary to perform the functions and meet the objectives of this Directive. This includes major subcontractors.
- The Fire Prevention Inspection Program shall apply to all site activities, including operations, demolition, and construction. In order to accomplish the activities of the Fire Marshal's Office, qualified fire protection engineers and fire protection staff shall be provided within the Fire Marshal's organization as necessary to perform the functions and meet the objectives of this Directive.
- An analysis, following the graded approach must be performed to demonstrate that a radiological or hazardous material release is not possible in deactivation, decommissioning, or demolition facilities desiring to remove fire protection systems from service. The analysis must be performed or reviewed by a qualified Fire Protection Engineer.
- Fire protection facility and programmatic assessments shall be performed by a qualified Fire Protection Engineer.
- Fire hazard analyses must be performed under the direction of a qualified fire protection engineer.
- Fire system restrictions and impairments that cannot be corrected in specified timeframes (15 days and 24 hours, respectively) require Fire Marshal and Fire Protection Engineer approval for extension and corrective action plans.
- Engineering design and review, as well as fire system construction and final approval, are required to involve a Fire Protection Engineer. The Contractor must also have processes in place to address these aspects of the overall engineering programs. As well, a self-assessment of these programs, specific to fire protection, is part of larger programmatic self-assessments that are required.
- Fire Protection Engineers are members of the Fire Protection Forum.

Programmatically, these requirements are implemented via a number of different organizations within Fluor Hanford. Primarily, the Fire Protection Engineers themselves are either directly under the organization of the Fire Marshal or report directly to the Projects. Those that report directly to the Projects have ties to the Fire Marshal's Office via formalized agreements that ensures that a consistent approach is maintained within the Fluor Hanford system.

### **Supporting Objective FP.3.1**

*The Contractor has an adequate number of fire protection engineers and/or technicians.*

At present, there is at least one Fire Protection Engineer within each Fluor Hanford Project area. Conversations with the Fire Marshal and the respective Fire Protection Engineers indicate that staffing is available for most of the engineering and safety related duties assigned over the course of a single year, with some burden placed on the existing personnel regarding those tasks at peak periods.

At present, there is at least one vacancy within the Fire Marshal's Office, and an identified need within each Project, although it is generally recognized that no single Project has need for an entire full time employee. Specific periods of the year or specific projects have placed burdens on the personnel due to their inclusion on a variety of programs. In such times, assistance is often sought from other Project Fire Protection Engineers (as time would permit) or from subcontractors outside Fluor Hanford. However, it is recognized that some of the issues raised within this assessment indicate a need for both increased technical and administrative support personnel.

Given this, the Assessment Team recognizes that current staffing is generally adequate, but increasing demands being placed on the Fire Protection Engineers and Fire Marshal's office may soon necessitate additional technical and administrative assistance (see FP.1 for more information).

### **Supporting Objective FP.3.2**

*Contractor fire protection engineers and/or technicians are qualified for the work being performed.*

RLID 420.1 and the supplemented CRD include a definition for "qualified" to be applied to Contractor personnel. The definition is as follows:

*An engineer that is a graduate of an accredited university or college with a Bachelor of Science in an engineering or related technical field and meets the qualifications for Member Grade in the Society of Fire Protection Engineers, or an engineer that has a member grade in the Society of Fire Protection Engineers, or an engineer that is a Registered Professional Fire Protection Engineer.*

A review of résumés of, as well as conversations with, each of the Fire Protection Engineers, indicates that all nine of the personnel meet the requirements of qualified, as indicated in the RLID. It is well acknowledged by Fluor Hanford that the current group of Fire Protection Engineers each has their own areas of expertise, and that an attempt has been made to establish the widest range of skills as possible. Any limitation in knowledge or experience is generally made up via assistance from an internally recognized person with the most experience in a particular topic. If such talent is not available from within, outside assistance is sought via contacts across the DOE and other industry areas.

The level of competency of the Fire Protection Engineers is generally high in most technical areas, such as general fire safety concerns, evaluations of fire systems, and life safety. However, an acknowledged limitation of the personnel is in the realm of analytical evaluations. The Fire Protection Engineers have some knowledge of calculative methods and fire modeling, and can more or less review documents submitted to them, to a degree. However, the expertise to perform the actual modeling or interpret changes in conditions using existing information would require additional education. In general, Fluor Hanford seeks assistance from subcontractors for these services, which is what is minimally required by the DOE Orders (i.e., “access to” such professionals, as opposed to having them on-staff). Under current circumstances, this is acceptable. However, the shift toward alignment of Fire Protection and Nuclear Safety analyses could raise this concern to the fore, as such detailed analysis will likely be required to support Nuclear Safety modeling and evaluation of fires. While acknowledged that having such capabilities on-staff is not *required*, it would certainly be advantageous to Fluor Hanford overall.

### **Supporting Objective FP.3.3**

*Contractor fire protection engineers and/or technicians are provided Site required training.*

The Team associated with the Hanford Fire Department Needs Assessment identified that a review of the training and qualifications for the Fire Marshal and Fire Protection Engineers indicates that, in general, the personnel are trained for Site access and operations as needed for their positions. As with any organization at Hanford, there are instances of delayed or missed training, but there are no indications that this is a fire protection specific concern or that it impacts the overall ability of the Fire Protection Engineers to perform their DOE mandated tasks or to meet customer service needs.

### **Supporting Objective FP.3.4**

*Contractor fire protection engineers and/or technicians are provided opportunity for continued professional development via Contractor programs.*

The Hanford Fire Department Needs Assessment Team did note a concern with professional development training. While efforts were generally made to provide Fire Protection Engineers with professional development training, such training was typically limited to local classes and inter-company efforts to share experience. This was due, in part, to restrictions in travel budget, not necessarily training or reimbursement funding. Because of the remote location of the Hanford Site and the limited exposure to national training that the area receives, the Needs Assessment made a recommendation to seek out better ways of providing professional training for the non-response staff (including the Fire Protection Engineers). Fresh perspective and cutting-edge information can be provided that would be otherwise lost in the limited contacts available to the local area. This assessment echoes that concern.

### **Supporting Objective FP.3.5**

*The Contractor has procedures to control engineering design and review of fire protection systems and equipment and conditions that impact fire protection, including specialized hazards, within Facilities and Areas of contractual obligation.*

Fluor Hanford, being a primary Project Hanford Management Contractor, has a broad range of implementing procedures. Relative to engineering practices, HNF-8002 and HNF-PRO-1819 provide the basic framework for the Site. Additional instruction is provided in HNF-PRO-1997 through HNF-PRO-2001. Although fire protection systems are not specifically identified in these documents, the basic references to safety systems and equipment are. However, HNF-PRO-1819 specifically identifies HNF-RD-9118, which provides the basic requirements for fire protection design in existing and new projects. As well, HNF-PRO-1819 provides requirements that work package managers and developers seek fire protection input, particularly on those systems and operations that have direct impact on the fire and/or life safety of the facility.

HNF-RD-8635 contains provisions for fire protection review of any procured item that is considered Safety Class, Safety Significant, or General Service or procured at Quality Levels 1, 2, or 3 and review of work documents affecting any items designated Safety Class or Safety Significant, all in accordance with the designators identified in HNF-PRO-259.

Conversations with the various Fire Protection Engineers and the Fire Marshal indicate that the process generally is working. For obvious reasons, the Fire Protection Engineers receive work packages that have clear fire protection or life safety implications. System modifications, building floor plan modifications, and work on FHA- or AB-credited systems are usually supplied to the Fire Protection Engineers without fail. Any work that requires a permit from the Fire Marshal's Office (e.g., hot work, tar kettles, torch-applied roofing, etc.) will also receive review by the Fire Protection Engineers. The Fire Protection Engineers demonstrated, via interview and discussions about current projects in the design or construction phase, that they are knowledgeable of the underlying engineering expectations of the DOE requirements documents and the national codes and standards directed by those documents.

The Fire Protection Engineers related colloquial information indicating that projects that appeared to have no fire protection or life safety implications did, in fact, impact those safety areas. It was noted that, in most cases, these concerns were minor and were corrected during various phases of engineering implementation, ranging from work package development through construction acceptance. However, there were also instances that included larger impacts that required significant involvement of the Fire Marshal's office to assist in correction of the concern. The Project Fire Protection Engineers indicated that such incidents were decreasing due to changes in the engineering processes, education of work package managers, and efforts developed through the Fire Marshal's Office and the Fire Protection Forum (both "Noteworthy Practices" in *Comprehensive Fire Safety Review: The Hanford Site*) to more clearly delineate the implications of the Fire Protection Program to seemingly unrelated work. These issues are identified in the *Comprehensive Safety Review* (see P. 7 of that report) and are part of the larger issues in the DNFSB's TECH-27 technical paper on fire safety at DOE facilities. Improvements since the issuance of that report were noted by both the Fire Marshal and the Project Fire Protection Engineers, however the efforts to change this concern are "cultural" in nature and require not just a change in the Site's documentation, but a shift in the perspectives of Design Authorities, design engineers and architects outside the fire protection field, work package managers, and others. Because of this necessary shift in culture, changes in the overall system are not expected to be swift nor comprehensive. However, there is an expectation that efforts toward improvement will continue.

During facility surveys, Facility Managers and Design Authorities were interviewed to determine a non-fire protection perspective, and the concerns noted previously were also related from these personnel. Due to the issues raised from two documents produced by the DNFSB (TECH 27 and TECH 30), a heightened awareness of the interaction of fire and life safety concerns with a range of facility and management programs is evident. While it is acknowledged that the conditions that lead to a lack of fire protection involvement on a project or work scope will not disappear, the current attitude indicates an improvement over previous experiences and a desire to improve.

The decrease in conflict with or lack of involvement of Fire Protection Engineering in the overall engineering program could only be identified within the Fluor Hanford organizations. Interface with other contractors is thought by the Fire Protection Engineers to be improving with efforts by the Fire Marshal's Office and the Fire Protection Forum. Interviews with the Project Fire Protection Engineers indicates that good working relationships and a certain amount of trust is present and improving between Fluor Hanford personnel and those Engineers responsible to other contractors. In joint responsibility facilities, such as T-Plant, questions regarding the interface to the Fire Protection Engineer, Facility Manager, and Shift personnel all indicated that the relationship is working well on all levels, but particularly well with respect to fire protection.

There were noted conflicts – such as those being experienced between the HFD and the Waste Treatment Plant regarding interface with the Site's water and fire alarm facilities – that cross not only contractor boundaries, but also DOE Office responsibilities. These conflicts are currently being primarily taken on by the Fire Marshal's Office, with some results. However, these conditions will likely continue and will require the assistance of the DOE Offices for mediation and resolution.

### **Conclusion:**

The Fire Protection Engineering portion of the Fire Protection Program meets the expectations of the DOE Orders and DOE Richland Office supplemented criteria. There are concerns identified, both from interviews and from external assessments, of a lack of fire safety involvement in all desired aspects of facility and engineering programs. There is also an increasing awareness of the overall concerns and improvement in interfaces that seek to rectify the conditions that lead to such conflicts. Modifications in engineering and change control procedures, attention by management groups, and education activities from the Fire Marshal's Office and Fire Protection Forum aid in addressing this concern. While continuing issues related to this concern are acknowledged, the current enhancements and identified need for further improvement are notable.

Specific to the Fire Protection Engineering program, there is an acknowledged concern for professional development. As is noted in the Hanford Fire Department Needs Assessment, the opportunities for professional development of the Fire Protection Engineers is limited due to the location of the Hanford Site and the funding available for travel to obtain remote training. Discussions with the Fire Protection Engineers regarding the types and scope of training that has been obtained in the past year, indicates that the training is helpful but will eventually lead to stagnation due to limited topics and resources.

There is also an acknowledged limitation for highly analytical or calculative methods. It was noted during interviews and discussions that the Fire Protection Engineers have varying degrees of knowledge of and comfort with analytical methods and fire modeling techniques, however

each acknowledged the limitations of their knowledge and their ability to work with such methods. Fluor Hanford has access to a number of external sources (subcontractors) to assist with this concern at present, but acknowledges that in-house capabilities would significantly improve the overall abilities of the organization, particularly in reference to the current shift toward alignment of the Fire Protection and Nuclear Safety programs.

**Issues:**

1. Overall, the Fire Protection Engineering program is adequate, with Engineers that meet the definition of “qualified” (as delineated in DOE Richland Office documents) and that have the requisite knowledge to perform assigned job duties.
2. Professional development training for Fire Protection Engineering professionals is limited and restricts the capabilities available to the Site in general.
3. The training and qualifications of the Site Fire Protection Engineers does not provide for in-house performance of analytical evaluations such as fire modeling or assessment of hazardous conditions via calculations. While current practice is to obtain such services from sources outside the Site, the alignment of the Fire Hazards Analyses and Authorization Basis documents is expected to increase the need for Site-based knowledge.
4. Conversations with the Fire Marshal and project fire protection engineers indicate there are concerns regarding the inclusion of fire protection personnel in review and approval of work packages that influence fire protection and life safety issues. This was further documented in the 1999 Hanford Site Fire Protection Engineering Value Engineering Study where fire protection engineer input was not considered in projects like the Effluent Treatment Facility and the Waste Receiving and Processing Facility. The lack of fire protection engineer input into these projects resulted in fire protection design deficiencies that required costly change orders. The conditions are improving as the result of efforts by the Fire Protection Forum and Fire Marshal, as well as changes in work control documents. Continued improvement is expected both due to these improvements and the continuing education of work control managers.

## **Fire Prevention**

### **Objective FP.4 – Fire Prevention**

The Contractor has an implemented Fire Prevention program.

**Supporting Objective FP.4.1.** Periodic fire prevention inspections are performed.

**Supporting Objective FP.4.2.** Facilities and Areas have procedures or methods for controlling combustible, flammable, radioactive, and hazardous materials so as to minimize the risk from fire.

**Supporting Objective FP.4.3.** Smoking is limited as an ignition source.

**Supporting Objective FP.4.4.** Hot work controls are in place.

#### **Criteria:**

1. The Contractor has a procedure or method for ensuring periodic fire and life safety inspections are performed for all Facilities and Areas under contractual obligation to the Contractor.
2. The Contractor has procedures or methods for controlling combustible materials and hazardous materials (including radioactive material) to minimize fire risks.
3. The Contractor has a policy or programmatic statement restricting smoking where such activity is a significant fire hazard.
4. The Contractor has or complies with a hot work permitting system. The hot work permitting system is in compliance with NFPA 51, 29 CFR 1910, and Improved Risk (Factory Mutual, Industrial Risk Insurers, etc.) guidelines.

#### **Approach:**

1. Validate that a procedure or formal methodology for performing periodic fire and life safety inspections on all Facilities and Areas exists. Review the procedure or other documentation to ensure that adequate instruction is provided to ensure that all buildings are inspected to appropriate criteria, as defined by the Fire Protection Program document. Validate, via sampling of inspection records, that inspections are being performed and that adequate attention is being provided to life safety and high fire risks.
2. Validate that the Contractor has a policy or programmatic statement that restricts smoking in areas of high fire concern (inside Facilities, wildland areas, near flammable liquids storage tanks, *etc.*). Validate through observation and interview if the policy or programmatic statement is being implemented.
3. Validate that the Contractor is performing hot work in accordance with a permitting system. Obtain and review the permitting process procedure to ensure that requisite standards – particularly NFPA 51 and 29 CFR 1910 – are being implemented. Investigate both a

permitted welding area and a field welding operation to determine if the hot work process is being followed.

**Basis:**

Fire prevention activities form one of the core functions of any Fire Protection Program. Fire prevention often involves aspects of minimizing combustibles, reducing hazards, and eliminating ignition sources. Frequent inspections ensure that combustibles and hazards are managed on a continued basis. Smoking and hot work are amongst the most common ignition source. Their control or elimination can reduce the overall hazard to a facility significantly.

**References:**

DOE O 420.1, Contract Requirements Document, Sections 4.2 and 4.2.1.  
RLID 420.1, Section 6.2  
[CRD Supplemental 420.1, Section B 4]

**Interviews:**

As needed to determine implementation.

**Observations:**

As needed to determine implementation.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August 2001.
- Fire Hazards Analyses:
  - SD-WM-FHA-019, *Fire Hazard Analysis for Building 225-B Waste Encapsulation and Storage Facility (WESF)*, Rev 1B, December 1998.
  - SNF-4268, *Fire Hazard Analysis for the Cold Vacuum Drying Facility*, Rev. 1, September 2000.
  - HNF-SD-HT-FHA-003, *Building 327 Fire Hazard Analysis*, Revision 1, January 2000.
  - HNF-SD-CP-FHA-002, *Fire Hazards Analysis for the T Plant Complex*, Revision 1, June 2001.
  - HNF-SD-HT-FHA-002, *324 Facility Fire Hazards Analysis*, Rev. 1, March 2000.
- Site Wide Documents:
  - HNF-RD-9900, *Hot Work Performance Requirements*, Revision 0, February 2002.
  - HNF-PRO-43, *Smoke Free Workplace*, Revision 1, November 1997.
  - A6000-895.1, *Hotwork Permit*, February 2002.
  - HNF-RD-10606, Rev. 0, *Fire Protection Program Requirements*, April 2002.

- HNF-RD-9717, *Fire Prevention for Construction/Occupancy/Demolition Activities*, Revision 1, April 2002.
- HNF-RD-9390, *Fire Hazards Analysis Requirements*, Rev. 0, Project Hanford Requirements Document, February 2002.
- HNF-RD-9391, *Fire Protection Assessments*, Rev. 0, Project Hanford Requirements Document, March 2002.
- Project Hanford Management Contractor Documents:
  - EO-040-002, *Waste Encapsulation and Storage Facility (WESF) Perform General Surveillance*, Revision/Change G-7, May 2002.
  - EO-100-003, *Waste Encapsulation and Storage Facility (WESF) Perform Process Cell Transfers*, Revision/Change E-2, June 2002.
  - EO-020-001, *Waste Encapsulation and Storage Facility (WESF) WESF Hot Cell Combustible Material Inventory*, Revision/Change B-0, May 2002.
  - FP-4-014-002, *Spent Nuclear Fuel Project Fire Protection Program*, Rev 2, (Page Change B), May 2001.
  - HNF-IP-1264, *324/327 Facilities Stabilization Projects Administrative Manual*, Revision 3, March 2002.
  - CP-24-001V, *Control of Combustible Materials Within CVDF*, Revision 0, Change A, July 2000.
  - OP-06-002W, *Perform Routine Rounds at 105-KW*, Revision 14, May 2002.
  - OP-06-002W, *K West Round Sheet*, Revision 14, May 2002.
  - OP-06-001E, *Perform Routine Rounds at 105-KE*, Revision 8, May 2002.
  - OP-06-001E, *K East Round Sheet*, Revision 8, May 2002.
  - DO-040-016, *Treatment Facility Perform Weekly and Daily Surveillance of Waste Management Areas*, Revision/Change F-1, October 2000.
  - DO-040-004, *T Plant Operating Procedure, Perform Surveillance of Treatment Facility Emergency Equipment*, Revision/Change D-4, January 2002.
  - LO-040-101, *Analytical Services 222-S Complex Building Inspection*, Revision 2, May 2002.
  - HNF-8663, *Fluor Hanford Requirements Management*, Revision 0, January 2002.
- Facility Rounds and Related Documentation:
  - A-6000-895.1, *Hotwork Permit*, JHA ID 1K-1911, Permit ID 1911-001, Work Request 1K-02-00012K, May 2002.
  - OP-06-001E, *K East Round Sheet*, Revision 8, Completed for Rounds conducted on June 20, 2002.
  - LO-040-101, *Analytical Services 222-S Complex Building Inspection*, Completed for Rounds conducted June 26, 2002.
  - *Building 327 Hot Cell Combustible Loading Summary*, April 23, 2002.
  - TF-OR-A-02, *242-A Evaporator Backside and LERF Rounds*, April 22, 2002
  - TO-600-300, *Liquid Waste Processing Facilities Perform Closeout Inspection In Evaporator Room and Pump Room*, August 31, 1998.

**Personnel/ Positions Interviewed:**

Operations Supervisor

Fire Protection Engineer (Fire Marshals Office)

Fire Protection Engineer (Building/Facility)

Facility Representative

**Evolutions/Operations/Shift Performance Observed:**

All buildings were toured during normal activities.

**RESULTS:**

**Discussion of Results:**

DOE Order 420.1, Section 4.2.1, describes the requirements of a fire prevention program. Per Item 2, written fire safety procedures that govern the use and storage of combustible and flammable materials are required so as to minimize the risk from fire. Item 2 also requires written procedures for activities such as smoking and hot work and other fire prevention measures that contribute to the decrease in fire risk.

DOE Order 420.1 is implemented at the site level via RLID 420.1 [and CRD 420.1 Supplementary Facility Safety]. Section 7.0 summarizes the general requirements for a combustible control/housekeeping program. For areas subject to significant life safety risks, serious property loss, program interruption, or loss of safety class equipment, as defined in the Safety Analysis Report (SAR), additional protection measures may be necessary. Such measures include administrative procedures and other programmatic fire safety activities that control hazardous substances and processes.

The DOE Orders are implemented at the contractor level through Standards/Requirements Identification documentation (HNF-8663) and several requirements documents, such as HNF-RD-10606 (*Fire Protection Program Requirements*), HNF-RD-9717, *Fire Prevention for Construction/Occupancy/Demolition Activities*, HNF-RD-9390, *Fire Hazards Analysis Requirements*, and HNF-RD-9391, *Fire Protection Assessments*. The Fire Protection Program requirements documents specifically require the Hanford Fire Marshal to approve hazardous activities, such as hotwork. Other aspects of the fire prevention program, such as smoking, housekeeping, and combustible controls are addressed via implementation of FHA and Fire Protection Assessment (FPA) recommendations.

At the facility level, the Fire Protection Program is implemented through a combination of procedures (site wide or facility specific) that may originate in the FHA and FPA documents; DOE directives (smoking), Operational Safety Requirements (OSRs), *etc.* The Project Fire Protection Engineer is typically responsible for ensuring that the procedures are addressed. Daily, weekly, and monthly rounds may be conducted by building personnel and/or a fire protection engineer.

The following buildings were used to compile this CRAD:

- Buildings 105 KE and 105KW (K-Basins)
- Building 221-T (T-Plant)
- Building 222-S
- Building 225-B, WESF
- Building 242-A
- Building 324
- Building 327

- Canister Storage Building (CSB)
- Cold Vacuum Drying Facility (CVDF)

The degree to which the prime CRAD objective is met was assessed through document review (FHA, AB documents, facility procedures, administrative controls, requirements documents, *etc.*), personnel interview, and tours of the listed buildings. This CRAD only considers specific facilities and the fire prevention program as it relates to these facilities. Site wide issues, such as wildland fires, are not considered.

Compliance with the primary objective, that the Contractor has an implemented Fire Prevention Program, is assessed via the four supporting objectives FP.4.1 through FP.4.4. The degree to which the supporting objectives are met is evaluated using a combination of document review, personnel interviews, and site surveys. The primary documents reviewed by the building procedures and administrative controls, building requirements documentation, fire protection assessments, DOE memoranda and directives, and other related documents. The FHA and AB documents were consulted where appropriate.

#### **Supporting Objective FP.4.1**

*Periodic fire prevention inspections are performed.*

This supporting objective is met.

Nine facilities were toured and most were found to use some type of housekeeping or combustible control procedure. Daily, weekly and monthly inspections were used to control combustible material in various spaces, typically those identified in the Fire Hazards Analysis document. Rounds sheets from several buildings were obtained and reviewed. The housekeeping procedures varied from facility to facility in terms of their depth and focus. Some buildings have housekeeping procedures that include inspecting the exterior of the building for brush, regulating smoking locations, and require inspection of life safety equipment (emergency lighting). As a minimum, all facilities housekeeping included combustible controls.

Life safety inspections are generally conducted through the following channels:

- FHA, fire assessments;
- Daily, weekly, monthly inspection rounds (emergency lighting, fire extinguishers, blocked egress paths, *etc.*); and
- The building Fire Protection Engineer.

Refer to the Life Safety Criteria Review and Approach Document (CRAD FP.8) for specific programmatic issues regarding life safety.

#### **Supporting Objective FP.4.2**

*Facilities and Areas have procedures or methods for controlling combustible, flammable, radioactive, and hazardous materials so as to minimize the risk from fire.*

This supporting objective is not met.

Although most facilities considered in this document have some form of housekeeping procedure or combustible control, in many instances the procedure or methods were vague or only focus on certain areas. Examples of this are as follows:

- 105 KW/105KE 105KW and 105KW use a housekeeping procedure that is followed daily. This procedure includes some combustible control items, however these are vague and are not linked to the Fire Hazards Analysis or Fire Protection Assessment documents. Examples of the controls are:
  - Flammable and combustible materials are limited to quantity to meet current needs.
  - Flammable and combustible materials are separated from ignition sources.
  - Flammable and combustible liquids shall be kept to minimal levels.
  - Storage of all materials is neat and in a designated location.

One housekeeping control item limits combustibles to twenty bags of waste. The controls cited above are largely subjective such that marking an unsatisfactory condition on the rounds sheet would be difficult defend because a contrary argument could readily be made. In addition, the buildings contain exposed structural steel and safety class equipment that are not considered in the combustible controls.

- 221-T (T-Plant) The housekeeping and combustible control procedures used by the T-Plant originate from FHA fire scenarios in the Canyon area. At the time the FHA was prepared, the Canyon contained a substantial fuel load, and because of the high radiological contamination present, was of immediate concern. The combustible controls adequately address this area and the fire potential is significantly reduced. Other areas of the building that were not considered in the FHA, such as the Pipe Gallery and the Electrical Gallery were noted to have significant combustible fuel loads ("Class A" and combustible liquids). There are currently no housekeeping procedures or combustible controls for these areas. Although the galleries are bounded by substantial construction, there is a potential for a significant fire.
- Building 222-S Building 222-S has no specific combustible control or housekeeping procedure. Some combustibles, specifically combustible liquids, are controlled via other procedures and requirements. Combustible liquids are required to be stored in approved cabinets and the total building inventory is limited based on applicable laboratory codes (NFPA 45 and NFPA 30). Although there were no significant combustible loading problems noted in the laboratories, there is no specific programmatic procedure for the building fire protection engineer to follow to limit accumulations in various spaces.
- Building 242-A Building 242-A has two housekeeping procedures. The TF-OR-A-02 procedure requires personnel to inspect for "Wet floors, exposed wiring,

housekeeping, belt guards not installed, water leaking onto electrical equipment, etc., and TO-600-300 to inspect for “loose debris (e.g., rags, laundry, trash, etc.)” and “transient combustibles”. There are no combustible control procedures that address assumptions of the fire hazard analysis.

- Building 324 Building 324 uses a hot cell combustible loading procedure that is based directly on the Fire Hazards Analysis. There are no specific procedures for controlling combustible materials in other areas, particularly the operating galleries and storage areas. The building fire protection engineer indicated that large concentrations of combustibles are addressed during the inspection rounds, however there is no specific criteria. Some areas were observed to have large quantities of “Class A” combustible material staged.
- Building 327 Building 327 uses a hot cell combustible loading procedure that is based directly on the Fire Hazards Analysis. There are no specific procedures for controlling combustible materials in other areas, particularly the operating galleries, the basement, and the storage areas. It was apparent during the survey that large quantities of “Class A” combustible material could accumulate in areas without any control or limits. This was of particular concern in the basement because of the low ceiling, unprotected steel, and radiological contamination.

The housekeeping procedures and combustible controls in the CVDF and in WESF are in greater depth and are more specific than those cited above. CVDF in particular addresses combustible material separation from safety class systems and uses combustible limits established in the FHA documentation. WESF uses FHA limitations for the hot cells and galleries; safety class equipment is not specifically addressed.

#### Vegetation Management And Exterior Combustibles

All facilities were found free of combustible vegetation accumulations. Maintaining the area free of combustibles was conducted via housekeeping procedures or specific procedures for addressing vegetation accumulations (K-Basins).

#### **Supporting Objective FP.4.3**

*Smoking is limited as an ignition source.*

This supporting objective met. Site policy (HNF-PRO-43) prohibits smoking for health reasons in all buildings and Government vehicles. Smoking is only allowed in designated areas and smoking debris is discarded in ash cans. Some facilities include smoking policies in the housekeeping/combustible control procedures/administrative controls (K-Basins, T-Plant). In addition, all facilities toured were free of combustible brush and other materials in the smoking areas.

Additionally, the Fire Marshal is working with the Benton County Sheriff to determine ways of discouraging drivers from discarding smoking materials from vehicles. Because of the wildland

fire hazard and the lack of control over such conditions, means ranging from education to fines are being investigated.

Two minor problems were noted:

- Building 242-A uses a metal trash container as a cigarette receptacle. The trash container was about half-full with miscellaneous “Class A” combustible material. Although the container was near a concrete wall, if combustible brush were to accumulate near the container and a cigarette ignited the contents, a spreading fire could result along the exterior of the wall.
- There was considerable cigarette debris scattered around the ash receptacle area of 105KE, suggesting that cigarettes are routinely discarded on the ground.

#### **Supporting Objective FP.4.4**

*Hot work controls are in place.*

This supporting objective is met. Facilities use a site wide hot work requirements document (HNF-RD-9900) for establishing fire protection criteria. HNF-RD-9900 is based on the requirements contained in NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and other Hot Work* and NFPA 241, *Safeguarding Construction, Alteration, and Demolition Activities*. Combustible separation requirements, shielding, fire retardant clothing, fire watches, and other NFPA controls are adopted in HNF-RD-9900. The requirements are implemented through a permit process (A-6000-895.1) that is approved by the Fire Marshals office. The permit functions as a procedure because the necessary controls and precautions are assessed on the permit itself.

#### **Conclusion:**

The fire prevention CRAD objective was assessed via four supporting objectives. Three of the supporting objectives were found to be adequately met: facilities, with few exceptions, have a housekeeping procedure and/or a combustible loading program that is routinely enforced during inspection rounds. Facilities limit common ignition sources, such as smoking and hot work either by limiting the activity to designated areas (smoking) or by a permitting system that requires the facility to adopt well established NFPA guidelines (hot work).

The supporting objective regarding the procedures or methods for controlling combustible materials is not fully met. Although most facilities do have such procedures or controls, they tend to be subjective or are limited to a few specific areas of the building. Subjective housekeeping procedures are difficult to implement because the interpretation will vary from individual to individual. Buildings that have good procedures in some areas may find unacceptable accumulations of combustible material in areas previously not considered. This is partially the result of the FHA and AB documents focusing on certain areas. When an unacceptable condition is found in these areas, a recommendation and procedure may follow, however that correct the problem in one area but may shift it to another area.

Building exteriors are maintained free of combustible vegetation. As well, control of combustibles on the exteriors of buildings was being performed adequately.

Overall the assessment Team concluded that the fire prevention criteria, review and approach elements of this area was partially met, because there are some areas that require improvement, specifically with regard to the depth of the combustible control/housekeeping procedures.

**Issues:**

Discreet housekeeping and combustible controls are often too vague or non-existent in a number of Fluor facilities. The housekeeping procedures and combustible controls need to be more specific in some cases or expanded to include other areas where fire hazards are present.

## **Fire Safety Training**

### **Objective FP.5 – Fire Safety Training**

Fire safety training is provided to employees.

**Supporting Objective FP.5.1.** General fire safety training is provided to all Contractor personnel.

**Supporting Objective FP.5.2.** Fire extinguisher training is provided to all Contractor personnel in accordance with 29 CFR 1910.157(g) and RLID 420.1, Section 8.13.

#### **Criteria:**

1. Fire safety is an included topic in Site orientation training.
2. Fire safety is an included topic in Site orientation refresher training.
3. Initial employment and annual refresher training for fire extinguishers is provided for all employees.

#### **Approach:**

1. Review the Contractor Site orientation training provided for all new employees. Ensure that fire safety is discussed and is adequate.
2. Review the Contractor Site orientation refresher training provided for all new employees. Ensure that fire safety is discussed and is adequate.
3. Interview Contractor personnel (number and specific personnel to be determined by the team lead) to ensure that the principles taught in the initial and refresher training are retained by Contractor personnel.
4. Verify that fire extinguisher training, as defined in 29 CFR 1910.157(g), is provided to Contractor personnel at time of employment (or as part of Site orientation training) and annually thereafter.

#### **Basis:**

Fire safety training aids in instilling Site personnel with the desired perspective toward fire prevention and fire safety.

#### **References:**

DOE O 420.1, Contract Requirements Document, Sections 4.2 and 4.2.1.  
RLID 420.1, Section 8.13

#### **Interviews:**

As required to determine implementation.

#### **Observations:**

None.

## **PROCESS:**

### **Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August, 2001.
- Contractor Documents:
  - Training Division intranet website

### **Personnel/ Positions Interviewed:**

Fluor Hanford HGET Point of Contact  
Fluor Hanford HGET (Fire Safety) Technical Authority  
Various Contractor personnel  
T-Plant Operations Supervisor

### **Evolutions/Operations/Shift Performance Observed:**

Took HGET Training as part of badging process.

## **RESULTS:**

### **Discussion of Results:**

#### **Supporting Objective FP.5.1**

*General fire safety training is provided to all Contractor personnel.*

General fire safety training is provided to all Contractor personnel as part of the Hanford General Employee Training (HGET) Program. HGET addresses training requirements for a wide-range of applicable DOE Orders, federal and state regulations. The HGET program meets the minimum initial and continuing training requirements. HGET applies to all Fluor Hanford, Inc. and subcontractor employees, vendors, and long-term (more than 7 days) visitors. HGET renewal is required on an annual basis.

There are two HGET courses applicable to Fluor Hanford employees: HGET-Full and HGET-Core. Fire safety training is presented in both courses. HGET-Full is taken every two years, and HGET-Core is an annual course taken during the “off” year. Therefore, all employees receive fire safety training annually.

The program is constantly under review and is revised on a regular basis to ensure that information presented is timely and accurate. The HGET Point of Contact is responsible for

obtaining material content review, input, and approval from the HGET Technical Authority for Fire Safety Training.

The HGET training is documented and is appropriate for general employee fire safety because it included good housekeeping practices, proper response and notifications in the event of fire, instructions on the use of portable fire extinguishers, recognition of potential fire hazards, and special extinguishing system hazards (e.g., safety training associated with halon systems).

### **Supporting Objective FP.5.2**

*Fire extinguisher training is provided to all Contractor personnel in accordance with 29 CFR 1910.157(g) and RLID 420.1, Section 8.13.*

The requirements of 29 CFR 1910.157 (g) states: “Where the employer has provided portable fire extinguishers for employee use in the workplace, the employer shall also provide an educational program to familiarize employees with the general principles of fire extinguisher use and the hazards involved with incipient stage fire fighting”.

The format and content of the fire extinguisher training included in HGET meets these requirements. As stated in Supporting Objective FP.5.1, fire safety training, which includes fire extinguisher training, is provided to all employees annually.

Additional hands-on fire extinguisher training is required and available as necessary for specific job duties (e.g., hot work fire watch).

### **Conclusion:**

The HGET training is documented and is appropriate for general employee fire safety because it included good housekeeping practices, proper response and notifications in the event of fire, instructions on the use of portable fire extinguishers, recognition of potential fire hazards, and special extinguishing system hazards (e.g.: safety training associated with halon systems), and instructions on the use of portable fire extinguishers. Employees, who perform fire watches also receive hands-on portable fire extinguisher training, as required by 29 CFR 1910.

Objective FP.5, Fire Safety Training is adequately implemented.

### **Issues:**

None.

## **Fire Hazards Analyses**

### **Objective FP.6 – Fire Hazards Analyses**

The Contractor has an implemented Fire Hazards Analysis program.

**Supporting Objective FP.6.1.** Fire Hazards Analyses are developed for all new facilities as directed by DOE Orders and standards and all facilities requiring a Safety Analysis Report by DOE Orders and standards.

**Supporting Objective FP.6.2.** Fire Hazards Analysis reports include all sections identified in RLID 420.1, Section 8.11, Section g.

**Supporting Objective FP.6.3.** A method or procedure is available for reviewing and updating Fire Hazards Analyses.

**Supporting Objective FP.6.4.** Fire Hazards Analyses are current and address hazards within the Facility or Area covered.

**Supporting Objective FP.6.5.** Accident analyses for fire and explosion contained in the FHA and the facility nuclear safety analysis documentation are consistent [see RLID 420.1, Section 8.11f (1)].

#### **Criteria:**

1. The Contractor has Fire Hazards Analyses for all Facilities or Areas under the contractual obligation of the Contractor that require Safety Analysis Reports (or other Authorization Basis documents).
2. The Contractor has a Fire Hazards Analyses, or plans to develop a Fire Hazards Analysis, for any Facility or Area in the design phase.
3. Fire Hazards Analyses are prompted for review and potential update via a procedure or other programmatic methodology.
4. Fire Hazards Analyses reflect current hazards and loss potentials.
5. Fire Hazard Analyses are developed jointly with nuclear safety documentation analysis.
6. Fire loss potentials (MPFL/MCFL) determinations are complete and reasonable.

#### **Approach:**

1. Obtain a list of current or planned Fire Hazards Analyses from the Contractor. Obtain a list of current or planned Authorization Basis Reports (Final Safety Analysis Report, Basis for Interim Operation, etc.). Compare the two lists to ensure that a Fire Hazards Analysis exists or is planned for each facility having an Authorization Basis report.

2. Determine via interview or document review how the Contractor reviews and updates Fire Hazards Analyses. Confirm that the frequency of review and update is consistent with the self-assessment periodicity identified in Supporting Objective FP.2.2.
3. Obtain copies of applicable FHA and nuclear safety documentation hazard/accident analysis and compare fire and explosion related events to determine if both are consistent as required by RLID 420.1, Section 8.11, f.
4. Obtain a copy of Fire Hazards Analyses (number and facilities at the discretion of the team lead) of Facilities or Areas under contractual obligation of the Contractor. Review the Fire Hazards Analyses with focus on described hazards, fire protection systems, and loss potential determinations. Particular attention should be given to wildland fire hazards and their impacts to the Facility or Area. Ensure that the hazards and mitigating systems described are consistent with those currently encountered in the facility. Ensure that Maximum Possible Fire Loss (MPFL) and Maximum Credible Fire Loss (MCFL) calculations are current and complete. The MPFL and MCFL calculations should include all fire impacts, including, but not limited to post-fire cleanup, smoke damage, impact to mission or production, and contamination spread.

**Basis:**

Fire Hazards Analyses are the baseline documents that describe the required fire protection systems and programs to offset fire concerns within a Facility or Area. Fire Hazards Analyses are used by fire protection groups to ensure that existing fire hazards and concerns do not exceed DOE loss expectations (the MPFL and MCFL) and do not impact assumptions in Authorization Basis documents. Given the weight of these concerns, continued review and update of the facilities is necessary.

**References:**

DOE O 420.1, Contract Requirements Document, Section 4.2.1.5

RLID 420.1, Section 6.2f

RLID 420.1, Section 8.11

Department of Energy Secretarial Memorandum, "Wildland Fire Safety Enhancements", January 19, 2001

"Initial Joint Review Of Wildland Fire Safety At DOE Sites", Department of Energy, December 2000

[CRD 420.1 Supplemental, Section B 1]

**Interviews:**

Perform interviews as needed.

**Observations:**

Perform field surveys as needed.

**PROCESS:**

**Records Reviewed:**

- Fire Hazards Analyses:

- HNF-SD-WM-FHA-024, *Fire Hazards Analysis for the 242-A Evaporator*, Rev. 0, September, 1997.
- HNF-SD-SNF-FHA-002, *Final Fire Hazards Analysis for the Canister Storage Building*, Rev. 2A, April, 2001.
- HNF-SD-SNF-FHA-001, *Fire Hazards Analysis for the K Basins Facilities at 100 K Area*, Rev. 1A, January, 2002.
- Hughes Associates, Inc., *242-A Evaporator Fire Hazards Analysis*, Westinghouse Hanford Company, Richland, WA, June 1994.
- SNF-4268, *Fire Hazard Analysis for the Cold Vacuum Drying Facility*, Rev. 1, September, 2000.
- SD-WM-FHA-019, *Fire Hazard Analysis for Building 225-B Waste Encapsulation and Storage Facility (WESF)*, Rev 1B, December, 1998.
- HNF-SD-HT-FHA-002, *324 Facility Fire Hazards Analysis*, Rev. 1, March, 2000.
- HNF-SD-CP-FHA-003, *222-S Laboratory Fire Hazards Analysis*, Rev. 0, August, 1999.
- HNF-SD-HT-FHA-003, *Building 327 Fire Hazard Analysis*, Revision 1, January, 2000..
- HNF-SD-CP-FHA-002, *Fire Hazards Analysis for the T Plant Complex*, Revision 1, June, 2001.
- Authorization Basis Documentation:
  - HNF-SD-WM-SAR-023, *242-A Evaporator Safety Analysis Report*, Rev. 3-E, Fluor Hanford, Richland, WA, August, 2001.
  - HNF-3553 Annex A, *Spent Nuclear Fuel Project Canister Storage Building Final Safety Analysis Report*, Rev. 1, February, 2002.
  - WHC-SD-WM-SAR-062, *K-Basins Final Safety Analysis Report*, Rev. 3L, December, 1999.
  - WHC-SD-WM-SAR-062, *K-Basins Final Safety Analysis Report*, Rev. 4A, December, 2001.
  - HNF-8659, *K Basin Fuel Transfer System Safety Assessment Project A.15*, Rev. 0, November, 2001.
  - HNF-3553, *Annex B Cold Vacuum Drying facility Final Safety Analysis Report*, Rev. 1C, November, 2001.
  - SD-WM-BIO-002, *Waste Encapsulation and Storage Facility Basis for Interim Operation*, Rev 1B, December, 2001.
  - HNF-SD-SPJ-SAR-001, *324 Building Safety Analysis Report*, Revision 4, April, 2002.
  - HNF-SD-SPJ-SAR-002, *324 Building Safety Analysis Report*, Annual Update, Rev. 2-A, Fluor Hanford, Richland, WA, January, 2001.
- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August 2001.
  - DOE-STD-3009-94, *Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports*, Chg. 2, Department of Energy, Washington, D.C., April 2002.
- Project Hanford Management Contractor Documents:

- HNF-8663, Rev. 0, *Fluor Hanford Requirements Management Functional Area Document*, Section 12, *Fire Protection*, January 22, 2002.
- HNF-RD-9390, Rev. 0, *Fire Hazard Analysis Requirements*, February 12, 2002.
- HNF-RD-8635, Rev. 1, *Review of Technical Documents*, June 14, 2002.

**Personnel/ Positions Interviewed:**

Fire Protection Engineers (Contractor)  
Fire Protection Engineers (Fire Marshal's Office)  
Facility Representatives  
Facility Safety Analysts

**Evolutions/Operations/Shift Performance Observed:**

Buildings were surveyed during normal activities.

**RESULTS:**

**Discussion of Results:**

DOE Order 420.1 requires "Fire hazards analyses (FHA) for all nuclear facilities, significant new facilities and facilities that represent unique or significant fire safety risks." As well, the DOE Order indicates that "The FHA shall be developed using a graded approach." RLID 420.1 extends the requirements of the DOE Order, with specific requirements included in Section 8.11. Likewise, the supplemented CRD O420.1 contains specific requirements in Section B 1. Contractor level implementation is achieved via HNF-RD-9390, *Fire Hazards Analysis Requirements*.

The FHA documents from nine facilities were reviewed and each building was subsequently toured. This CRAD is based on the following buildings/facilities:

- Buildings 105 KE and 105KW (K-Basins)
- Building 221-T (T-Plant)
- Building 222-S
- Building 225-B, WESF
- Building 242-A
- Building 324
- Building 327
- Canister Storage Building (CSB)
- Cold Vacuum Drying Facility (CVDF)

Other facilities, as specifically noted, may be included in the review process.

**Supporting Objective FP.6.1**

*Fire Hazards Analyses are developed for all new facilities as directed by DOE Orders and standards and all facilities requiring a Safety Analysis Report by DOE Orders and standards.*

HNF-8663, Section 12.3 provides the overriding Fluor Hanford implementation for Fire Hazard Analyses. Section 12.3 echoes the requirements spelled out in the DOE Orders. HNF-RD-9390

provides requirements to perform Fire Hazards Analyses, carrying over the specific requirements for implementation that are captured in HNF-8663. Both of these documents delineate the conditions under which a facility would require an FHA.

A comprehensive listing of buildings that require an FHA could not be identified, either within Fluor Hanford or DOE Richland Office. While the Fire Marshal's Office tracks all existing Fire Hazards Analysis documents to ensure that a record copy is available and that they are being kept current, there is no method to proactively identify buildings and structures that would require an FHA. The default decision appears to include facilities that have an existing Authorization Basis document, are considered high hazard in the opinion of the Fire Protection Engineers, or have a value exceeding specified limits. However, the latter two choices are dependent on the interpretation of the Fire Protection Engineer or Fire Marshal. Under the new supplemented CRD O420.1, there is an expectation for more specific clarification regarding "high hazard" facilities, as well as a more specific requirement to coordinate the FHA and Authorization Basis documents. Given this, a specific building list that is, minimally, coordinated with the buildings that are examined under Authorization Basis documents would be expected. This building listing would have to be coordinated with the DOE Richland Office to ensure that opinions regarding the actual hazard or potential loss are reconciled.

With respect to the Authorization Basis documents, there were not any specific areas where the list of FHAs did not correspond to the major buildings under evaluation by Authorization Basis documents. However, it is noted that this assessment is based on available information taken from the Hanford Intranet and a full evaluation could not be completed within the scope of this effort. A detailed search of each Authorization Basis document to determine the exact buildings under evaluation and a comparative examination of the Fire Hazard Analyses to ensure alignment was not performed. It is assumed that Fluor Hanford will work to perform this comparison during the current effort to align the Fire Hazard Analyses and Authorization Basis documents.

### **Supporting Objective FP.6.2**

*Fire Hazards Analysis reports include all sections identified in RLID 420.1, Section 8.11, Section g.*

This supporting objective is met because all Fire Hazards Analysis (FHA) documents examined included the sections required by RLID 420.1, Section 8.11.g. The facility FHAs used to assess this supporting objective were Buildings 105KE and 105KW (K-Basins), 221-T (T-Plant), 222-S, 225-B (WESF), 242-A, 324 and 327, the Container Storage Building (CSB), and the Cold Vacuum Drying Facility (CVDF). Some FHA documents included additional sections beyond that required by RLID 420.1, such as process descriptions.

### **Supporting Objective FP.6.3**

*A method or procedure is available for reviewing and updating Fire Hazards Analyses.*

HNF-8663, Section 12.3.j provides the criteria for implementation, as required by RLID 420.1. The requirements are then translated to HNF-RD-9390 for more specific implementation. The criteria reference directly back to RLID 420.1, Section 8.11.j(1) through (5). There is no specific

timeline for revision of the FHA, but is performance based with consideration toward changes in hazard or consequences. However, the FHAs are reviewed via the facility assessments performed by the Fire Protection Engineers (see CRAD FP.2 for more information). This review is the most obvious mechanism for flagging a need for change of the FHA document. Interviews with the Project Fire Protection Engineers indicated that they were cognizant that continuous review of the FHAs was needed to allow for “real-time” validation that the FHA analysis and assumptions were continuing to be upheld. This supporting objective is thus met.

#### **Supporting Objective FP.6.4**

*Fire Hazards Analyses are current and address hazards within the Facility or Area covered.*

This supporting objective is not met. Facility surveys were performed to obtain a general sense of whether or not the facility FHAs are current. Comprehensive comparisons of all aspects of the analyses were not performed, since such an evaluation is beyond the scope of this assessment. The primary focus of the surveys was to determine if the fire scenarios covered in the FHA documents reflected the conditions in the facilities. The FHA review and facility tours provided the following results:

- 105 KE The approved FHA captures the most severe hazards, but should be expanded to consider large “Class A” combustible fuel packages in and around the Transfer Area. This is predicated on the current presence of scaffolding, wood crates, and a canister cleaner structure with polymer windows being present in the Transfer Area. These items may be staged near unprotected structural steel and/or safety class equipment. There is also no direct control on the maximum quantity of these materials, indicating that accumulations could exceed the fire scenario fuel load assumed in the FHA in this area. Refer to CRAD FP.4 and FP.10 for discussions on the combustible loading programs.
- 105 KW The FHA fire scenarios agreed with the observed combustible fuel loading in the facility walkthrough. As noted in Building 105 KE, there is no direct means of controlling the accumulation of combustible materials, specifically in the Transfer Area where there is exposed structural steel and safety class equipment.
- 221-T (T-Plant) The FHA focuses on fire scenarios in the Canyon Area and provides recommendations for limiting the growth of fires in this area. Scenarios are also evaluated in the office areas (271-T). The building has since implemented the controls and the configuration in the canyon area is markedly improved. However, there was a significant accumulation of combustible materials in other areas that were not considered in the FHA, notably the pipe and electrical galleries. There is the potential for a post-flashover fire in these areas that could compromise the rating of the fire doors and possibly spread to other areas. There are no combustible controls enforced in these spaces.
- 222-S The fire scenarios in the FHA are consistent with the combustible fuel load and configuration observed during the facility tour.

- 225-B (WESF) The fire scenarios in the FHA are consistent with the combustible fuel load and configuration observed during the facility tour.
- 242-A The fire scenarios evaluated in Building 242-A were first postulated in 1994. They include specific fuel packages in the evaporator room, a control room fire, and an organic explosion within the waste stream. Based on the site survey, fire scenarios should be considered in the AMU room where there could be a greater flux of transient combustible materials, the Condenser Room, and a more refined evaluation of the waste stream scenario is necessary. No significant fuel packages were noted in the Evaporator Room.
- 327 The FHA evaluates most significant hazards in the facility and provides conservative conclusions. However, the 327 FHA did not fully address fire scenarios in the basement, particularly the “Class A” fuel packages that were observed during the assessment that could expose the unprotected structural steel. The FHA evaluated only a large ventilation-limited hydraulic fluid fire in the basement and concluded that structural failure is not likely. This FHA concluded that this fire would bound all others, although a smaller “Class A” fuel package or possibly a pressurized-spray fire could damage the steel (not ventilation limited where critical temperatures could be reached) and cause openings to develop in the floor. This is of particular concern because the same fire could also cause a radiological contamination release from the high efficiency particulate air filters. After the assessment, the facility removed a considerable amount of combustible materials from the basement to address this concern. However, formal controls to maintain combustibles at a safe level were not in place and the fire hazard analysis did not analyze for “Class A” combustibles that were stored in the basement at the time of the assessment. The FHA also does not consider a large “Class A” combustible fire in the gallery/canyon area that could expose the hot cells. Although a larger fire was previously considered, the facility has implemented controls and the operations have shifted to the point where other smaller fires may represent the greatest risk.
- 324 The fire scenarios in the FHA are consistent with the combustible fuel load and combustible configurations observed during the facility tour.
- CSB (Canister Storage Building) The fire hazards analysis evaluates several scenarios in the operational area and provides a basis for establishing combustible controls. However, a hydraulic fluid fire (pressurized spray fire) was not considered in the FHA and may pose significant hazard to safety class equipment (see CRAD FP.7).
- CVDF (Cold Vacuum Drying Facility) The fire scenarios in the FHA are consistent with the combustible fuel load and combustible configurations observed during the facility tour.

Overall, about half of the FHA documents were current. The remaining FHAs require updates to the fire scenarios.

### Wildland Fires

The FHAs do not incorporate wild land fire hazard evaluations as required by the *Initial Joint Review Of Wildland Fire Safety At DOE Sites* and the subsequent DOE Secretarial memorandum. The Secretarial memorandum requires implementation of all recommendations within the *Joint Review* document. The recommendations from the *Joint Review* include evaluation of direct exposure of wild land fires, evaluation of secondary hazards from wild land fires (e.g., flying brands to combustible structure or exterior nuclear storage), and evaluation of impacts to facilities due to smoke from wild land fires. While the first is performed in some of the FHA – as an example, in the FHA for the Cold Vacuum Drying Facility – the latter two are not addressed in any of the FHAs. As a result of the Cerro Grande Fire at Los Alamos and the 24 Command Fire at Hanford, as well as others, a noted concern exists with continued protection of facilities with smoke present. Such conditions can circumvent ventilation systems, harm required operators of facilities, or threaten exterior storage, even if the fire itself does not directly expose the facility. While the incorporation of wildland fire hazards into the FHA is not required by the contract until a modification implementing the inclusion of CRD 420.1 supplemental is made, the *Initial Joint Review of Wildland Fire Safety At DOE Sites* report has been out since December 2000 and the contractor could have easily incorporated these concerns into their FHAs during revisions with minimum efforts.

### **Supporting Objective FP.6.5**

*Accident analyses for fire and explosion contained in the fire hazard analysis and the facility nuclear safety analysis documentation are consistent [see RLID 420.1, Section 8.11f(1)].*

This supporting objective is not met.

The current safety basis (SB) and fire hazards analysis (FHA) for the following facilities were reviewed in detail: 242-A Evaporator, 324 Building, T Plant, 222-S Lab, and the Canister Storage Building. The SB consists of the documented safety analysis, the technical safety requirements, TSR's (or operational safety requirements, OSR's), and the safety evaluation report(s) for the facility. Hazards listed in the SB were compared to what was found at each facility during the tour to ensure that the SB and FHA are up-to-date and reflect the current hazards. The SB accident analysis was reviewed and compared to the fires analyzed in the FHA to ensure consistency. The SB analysis was reviewed for technical accuracy. Follow-up interviews were conducted with facility Safety Analysts and Fire Protection Engineers in order to clarify information and conclusions.

RLID 420.1, Section 8.11.f requires that the SB and FHA be consistent.

Several items were identified based on the review and surveys. These include areas where the SB documentation requires some minor technical improvements (based on the observed conditions and the FHA scenarios) and where there are some differences between the FHA and the SB documentation accident/fire scenarios.

### Technical Accuracy of the SB Accident Analysis

Minor improvements should be made in some facility accident analysis:

- The T-Plant SB (HNF-SD-WM-ISB-006, Rev 2) did not include Pu-240 and Am-241 in the material at risk during a fire in the 2706 T Building filters, although these radionuclides are assumed to be present under the worst case filter loading. Including these isotopes would approximately double the accident release to 40 mREM, on site.
- The T-Plant SB did not credit a two-hour fire wall between the 2706 T building and the adjoining filter house. However, the SB excludes the source term from material trapped in the filters during a fire, effectively crediting the two hour fire wall between the filter house and the main structure.
- The 222-S Lab SB states that a wildand fire causing ignition of the lab and surrounding facilities or ignition of waste boxes stored outside is extremely unlikely (1E-04- 1E-06/yr). Two wildand fires have occurred in the last 20 years at Hanford. While the Lab has not caught fire as a result, these hazard frequencies (two separate hazards) can be challenged as nonconservative.
- The 222-S Lab accident analysis assumes a radiological inventory (Table 4-7) based on “the more frequently sampled range of radionuclides.” This means that isotopes not frequently sampled for were simply ignored, regardless of whether they could actually exist in a sample and therefore be in the facility. Specifically, Pu-240, Pu-241, and Cm-244 were excluded, although they most certainly can be found in tank farm sludge samples. The radiological inventory is therefore not complete. Further, it is not clear that the inventory is bounding. Similar to the T Plant, the 222-S Lab assumes an inventory limit that is actually derived from sample averages, multiplied by the maximum number of samples the 222-S Lab allows itself to have, 1600. (Thus, the inventory is 1600 times the average sample inventory.)
- The SB for the 222-S Lab analyzes an earthquake/fire (i.e., an earthquake followed by a fire) as the worst-case accident. The analysis does not consider the seismic contribution to the accident, instead focusing solely on the release from the fire. The seismic release would be additive to the fire release. While a bounding release fraction is used for the fire, it is unclear that fraction can be defended for a fire following an earthquake (which would likely badly damage the hot cells containing the majority of the radiological inventory, resulting in a greater release by the fire). In any event, exclusion of the seismic contribution to the accident dose then means that the accident consequences (24 REM onsite, 11 mREM offsite) are underreported.
- Some facilities (*e.g.*, T Plant, 242-A Evaporator, 222-S Lab) were noted to calculate accident dose in units of Effective Dose Equivalent (EDE) REM, instead of the more modern Cumulative Effective Dose Equivalent (CEDE) REM.
- Analysis of a fire in B Cell in the 324 Building did not include the inventory in the HEPA vent exhaust filter immediately adjacent to the cell. This is not one of the main vent filters downstream. However, the inventory would be small compared to the significant remaining contamination on the Cell walls and floor.

DOE Standard DOE-STD-3009-94 requires determining unmitigated releases for accidents, i.e., without crediting active control features. Minor improvements were found to be needed in some facilities analyses:

- T-Plant assumes a limit on radionuclide content of waste drums or boxes brought into the facility. This inventory control is implemented as an OSR. The analysis does not calculate release from the worst case inventory that could be received. Rather, the control on inventory is credited and the worst case release calculated accordingly. It is not clear that such a method is unmitigated.
- The 242-A Evaporator assumes the feed from the double shell tanks is free of separable organics so that an organic fire/explosion is considered incredible. The SB assumes that quantities of oxidizing agents present in the feed could not result in a chemical reaction fire. Active interlocks and sampling features are credited to further prevent these accidents. Such a method is mitigated. Numerous active controls and features are credited to prevent an explosion/fire in the vessel vent system. This is likewise not unmitigated.
- The 324 Building analyzes a fire in an outside TRU storage pad. The analysis assumes a material at risk of 1 dose-equivalent curies. The analysis does not determine the worst-case radionuclide content of the drums that could be stored there. The highest historical TRU content is .1-.2 Ci, Pu-239 equivalent. Thus, the drum inventory limit is conservative. However, it is not clear that this method is unmitigated.

Consistency between the SB and the FHA

The review compared the FHA to the SB to ensure that similar fires are analyzed in each document. Some improvement is needed to improve consistency between the SB and FHA:

- The 222-S Lab FHA states (Section 1.3, first paragraph) that the types and quantities of combustible materials found during a facility tour are representative of the potential fire hazards in the Lab. The FHA then states that greater combustible inventories could affect the analyzed fires. In particular, greater amounts of flammable liquids could have a significant impact. However, the SB makes no mention of the limits assumed by the FHA and mandates no combustible control program at all (or Fire Protection Program, for that matter). The facility has no TSR's. Since the current control program uses only NFPA 45 limits, ordinary combustible inventory could be much higher than was assumed by the FHA.
- The 222-S SB states (Section 4.4) that a 'total burn of the radionuclide inventory is consistent between the FHA and ISB [SB].' This statement is not entirely correct. The FHA analyzed a fire that included the relatively minor contribution of material deposited in the 222-SC Filter House, which was burned along with the remainder of the facility. The SB did not include the contribution of the filter house.
- A "Class A" combustible fire in the 242-A Evaporator control room and a wood fire in the evaporator vessel room examined in the FHA are not analyzed in the SB. An organic waste/combustible liquid fire in condensate tank TK-C-100 examined in the FHA was

ruled out as incredible by the SB, using active controls and features. Such a fire was found by the FHA to result in an explosion, pressurizing the tank's enclosure to 5 psig, which could cause significant equipment and structural damage. The analysis in the SB assumes numerous controls and therefore was not unmitigated. That fire was dismissed by the SB as incredible based on those controls.

- The hazards analysis for the 242-A Evaporator does not identify a fire within the “power block” itself (*i.e.*, the plant and its support areas, such as the vent system) as a hazard at all, even though the FHA evaluates a “Class A” fire in the evaporator vessel room. Rather, the only evaluated fires are those involving flammable material received as evaporator feed, which was considered to be an extremely unlikely hazard. All other fires are considered incredible. An organic fire within the vent system was considered extremely unlikely by the hazards analysis, but was not evaluated as an accident. No fire was actually evaluated as an accident (*i.e.*, consequences were calculated). Rather, the SB states (Section 9.3.2) that evaporator operations present no credible uncontrolled chemical reactions (*i.e.*, fires). Heavy reliance is placed on active features and controls to reduce the probabilities to beyond extremely unlikely. As such, the SB analysis is mitigated. The SB goes on to state that the consequences of a fire analyzed in the FHA would be “relatively small” and bounded by the release from a design basis earthquake. No basis for this assertion was found. The release fractions for fires, particularly a fire involving liquid material (which is analyzed in the FHA), are significantly higher than for shock impacts from an earthquake.
- Both the T-Plant and 242-A Evaporator SB do not identify fire walls credited in the FHA to mitigate fires. In the case of T Plant, a two-hour fire wall separating the main 2706 T Building from the filter house prevents a fire in either space from affecting the other, but is so noted only in the FHA. No mention of this fire wall is made in the SB and the fire analysis separates the filter inventory from the storage container inventory (two separate fires are analyzed). The filters would in fact contribute additional inventory to the building fire that was analyzed, so that the reported consequences of the 2706 T Building fire would not be somewhat greater. In the case of the 242-A Evaporator, a four-hour fire wall around the evaporator vessel prevents propagation of a wood fire from the vessel room to the remainder of the facility. The SB makes no mention of the fire wall in preventing such a fire.
- The 242-A Evaporator FHA credits a specific operation to prevent an ammonia fire inside the evaporator vessel. This operation pressurizes and depressurizes the vessel at room temperature, which avoids creating flammable vapor mixtures in the vessel. However, the SB makes no mention of this procedure.
- The combustible loading limits (Section 6.4.1) set by the FHA for the 242-A Evaporator are not incorporated into the SB, nor even recognized as part of the Fire Protection Program. For that matter, the Fire Protection Program is not mentioned in the SB, nor is it included as an administrative control OSR.
- The 324 Building FHA analyzes a fire involving the entire building. However, the worst-case fire analyzed by the SB affects only the B Cell. B Cell contains the majority of the

Building's radiological inventory. There is additional inventory in the building. The SB assumes that inventory is small compared to B Cell. However, that inventory is not specifically stated in the SB. The inventory would include D Cell, waste drums and boxes, HEPA filters on the individual cells, and duct plateout.

- The 324 Building SB does not credit the number of HEPA exhaust filters assumed by the FHA in calculating the amount of combustible material allowed in the cells. The FHA assumes 40 filters (two trains of 20 filters in service). The number directly affects the calculations on which the allowed combustible inventory is based.
- The 324 Building FHA states that combustible loading limits (or compensatory measures) shall be imposed at all times. However, the facility OSR's only require the load limits during hot work (which the OSR defines) in the cells.

Comparison of FHA/SB Analyses to Current Facility Hazards:

The review compared the analyses provided in the SB and the FHA to the actual hazards seen during review team tours of the facilities. Both the SB and the FHA were expected to reflect current conditions and not reference dated or obsolete hazards that have been removed or no longer exist. At the same time, the analyses were expected to include all fire or explosive hazards evident from the facility tour. Minor deficiencies were found. Some improvement is needed so that the analyses contained in the SB and the FHA reflect actual conditions and remain topical:

- The 242-A Evaporator has not analyzed a fire in the K-1 exhaust HEPA filter trains. The filters are outside the power block, physically behind it, and exposed to the weather. While within a fenced enclosure, the filters are exposed to ignition sources from several sources, including vehicle impacts, fork lift fires, lightning, and hot work.
- A large fuel oil tank is within 50 yards of the 242-A Evaporator facility. The tank is above ground and contains at least 10,000 GAL. The hazards analysis has not considered the consequences of a fuel oil fire during Evaporator operation. Significant amounts of smoke would be generated which would be brought into the facility through the ventilation intake system. Filters would block the smoke until they plugged. After that point, smoke could break through the filters and fill the facility. Smoke could affect habitability of the control room, forcing an evacuation. No operator action is required to mitigate the analyzed accidents and it is expected that the Evaporator could be shutdown safely. Therefore, overall impact of such a fire is expected to be minor. However, this hazard has not been evaluated. An explosion of the package boiler has also not been analyzed, although such an accident is not likely to affect the facility.
- The FHA for T Plant states that the MPFL for the Canyon involves a 1000-pound "drag off" box. This box is no longer within the facility. It is stored outside the facility on a railroad spur. The hazard analysis does not examine in hazards to the box or hazards it might present itself, such as a fire. Further investigation determined that, according to available records, the box contains:
  - .0067 Ci, Sr-90

- .018 Ci, Cs-137
- .11 Ci, Pu-239
- .11 Ci, Pu-240
- 3.1 Ci, Pu-241, and
- .25 Ci, Am-241.

Therefore, the radiologic content of the box is minor and it does not represent a significant threat.

- A mixed waste storage pad exists in the NE corner of the T Plant site (outside). According to present approved safety analyses, up to 100 dose-equivalent curies of Pu-239 can be stored in that area. The area is immediately off an access road and does not contain any traffic barriers, other than a radcon chain around the pad. Drums could be impacted by a vehicle or forklift. While this accident has been accepted, some form of traffic barriers could be considered as defense-in-depth measures.
- The 324 Building has systems to extinguish fires inside the hot cells. These systems have water meters to shutoff the water after a certain volume, as a criticality protection feature. However, criticality within the cells is incredible, based on form and amount of fissile material remaining in the cells. The shutoff valves are no longer required. The hazard for which they were intended no longer exists.
- The 222-S Lab could be exposed to a range fire. The hazards analysis identifies a range fire as a credible threat to the facility. Nevertheless, such a fire is not further examined by the SB.

### **Conclusion:**

Although several of the supporting objectives for this CRAD are adequately addressed in the site program, the overall CRAD objective is not considered met because of the significant differences between the AB and FHA document fire scenarios (assumptions and results). In addition, several FHA documents did adequately reflect the current hazards in a facility. There is also no comprehensive list within Fluor Hanford of all facilities that are required to have (and actually have) an FHA.

### **Issues:**

1. Controls, conditions and assumptions of fire hazard analyses documents do not always flow down into facility controls. This was specifically noted in the 222-S lab FHA where the fire analysis states (Section 1.3, first paragraph) that the types and quantities of combustible materials found during a facility tour are representative of the potential fire hazards in the lab and that a greater combustible inventory could affect the analyzed fires. However, no formal combustible control procedure or program (other than for flammable liquids under NFPA 45) exists for the lab to ensure that the fire analyzed by the FHA will not be exceeded by additional inventory brought into the labs. In addition combustible loading limits defined by the 242-A evaporator FHA (Section 6.4.1) have not been incorporated into facility specific procedures to ensure that limits are not exceeded.

2. Fluor Hanford does not currently have or maintain a comprehensive list of the facilities that minimally require an FHA to be performed. While a method of tracking the existing FHAs is available, there is no method to ensure that the facilities required by DOE directives to have an FHA do, in fact, have one.
3. Due to the changing operations and activities, the fire hazards analyses do not always capture the current fire hazards. For example:
  - The fire hazards analysis for the canister storage building (CSB) evaluates several scenarios in the operational area and provides a basis for establishing combustible controls. However, a hydraulic fluid fire (pressurized spray fire) was not considered in the CSB FHA and may pose a significant hazard to safety class equipment.
  - The FHA evaluates most significant hazards in the facility and provides conservative conclusions. However, the 327 FHA did not fully address fire scenarios in the basement, particularly the “Class A” fuel packages that were observed during the assessment that could expose the unprotected structural steel. The FHA evaluated only a large ventilation-limited hydraulic fluid fire in the basement and concluded that structural failure is not likely. This FHA concluded that this fire would bound all others, although a smaller “Class A” fuel package or possibly a pressurized-spray fire could damage the steel (not ventilation limited where critical temperatures could be reached) and cause openings to develop in the floor. This is of particular concern because the same fire could also cause a radiological contamination release from the high efficiency particulate air filters. After the assessment, the facility removed a considerable amount of combustible materials from the basement to address this concern. However, formal controls to maintain combustibles at a safe level were not in place and the fire hazard analysis did not analyze for “Class A” combustibles that were stored in the basement at the time of the assessment.
  - The FHA for T-Plant focuses on fire scenarios in the canyon area and provides recommendations for limiting the growth of fires in this area. Scenarios are also evaluated in the office areas (271-T). The building has since implemented the controls and the configuration in the canyon area is markedly improved. However, there was a significant accumulation of combustible materials in other areas that were not considered in the FHA, notably the pipe and electrical galleries. There is the potential for a post-flashover fire in these areas that could compromise the rating of the fire doors and possibly spread to other areas. There are no combustible controls enforced in these spaces.
  - The FHA for 105KE captures the most severe hazards, but should be expanded to consider large “Class A” combustible fuel packages in and around the Transfer Area. This is predicated on the current presence of scaffolding, wood crates, and a canister cleaner structure with polymer windows being present in the Transfer Area. These items may be staged near unprotected structural steel and/or safety class equipment. There is also no direct control on the maximum quantity of these

materials, indicating that accumulations could exceed the fire scenario fuel load assumed in the FHA in this area.

7. The FHAs do not incorporate wild land fire hazard evaluations as required by the *Initial Joint Review Of Wildland Fire Safety At DOE Sites*. While inclusion of direct fire hazards are addressed in some FHAs, indirect fire and smoke hazards, as identified in the *Joint Review* are not. While the incorporation of wildland fire hazards into the FHA is not required by the contract until a modification implementing the inclusion of CRD 420.1 supplemental is made, the *Initial Joint Review of Wildland Fire Safety At DOE Sites* report has been out since December 2000 and the contractor could have easily incorporated these concerns into their FHAs during revisions with minimum efforts.
8. FHAs that have long standing recommendations that have not been corrected and are not being tracked.
9. Facility authorization basis documents and fire hazards analyses are not fully integrated. Generally, the fire hazards analyses postulate fire scenarios that exceed those considered in the authorization basis documentation. This is partially the result of the FHA and authorization basis requirements documents that specify assumptions and the focus of the analysis. Improved coordinated integration is needed between these two documents relative to fire hazards and where there are differences the documents should address the differences and justify the reasons.

## **Protection of Safety Equipment, Mission, Property, and Environment**

### **Objective FP.7 – Protection of Safety Equipment, Mission, Property, and Environment**

The Contractor demonstrates sound practices to protect safety equipment, mission, property, and environment.

**Supporting Objective FP.7.1.** Safety class systems are protected in accordance with Department of Energy Orders, codes, and standards.

**Supporting Objective FP.7.2.** Vital programs and missions are protected in accordance with Department of Energy Orders, codes, and standards.

**Supporting Objective FP.7.3.** Property, including high value equipment, is protected in accordance with Department of Energy Orders, codes, and standards.

**Supporting Objective FP.7.4.** Environmental protection from halogen agents and water runoff from fire protection is adequately addressed.

#### **Criteria:**

1. The Contractor demonstrates knowledge of the location of safety class systems and the desired level of protection in DOE Orders, codes and standards.
2. Adequate protection has been afforded to safety class systems.
3. The Contractor demonstrates knowledge of the location of vital programs and missions and the desired level of protection in DOE Orders, codes and standards.
4. Adequate protection has been afforded to vital programs and missions.
5. The Contractor demonstrates knowledge of the location of property, including high value equipment, and the desired level of protection in DOE Orders, codes and standards.
6. Adequate protection has been afforded to property.
7. Water runoff concerns are adequately identified and addressed.
8. A plan is in place to address and/or disposition any existing halogen agent fire extinguishers or fire suppression systems currently installed.

#### **Approach:**

1. Obtain copies of Fire Hazards Analyses (number and locations as determined by the team lead) and review for identification of safety class systems, vital programs or mission, high value equipment, and water runoff concerns. [Note: All of these concerns are required to be identified by RLID 420.1, Section 8.11 g or CRD 420.1 Supplemental, Section B 1] Ensure all these topics are discussed and are adequately addressed.

2. Validate via review of the current Authorization Basis for the same Facilities or Areas that identified safety class equipment are consistent between the two documents. Validate via field investigation that redundant means of fire protection are provided for safety class equipment that does not have redundant capabilities. Also validate that operation of any fire protection means will not intentionally damage the safety class system or that such damage has been included and accepted in existing safety basis analyses (Fire Hazards Analysis, Authorization Basis, etc.). Particular attention should be paid to protection of credited HEPA ventilation systems or other systems used to preclude the release of radioactive, toxic, or other hazardous materials.
3. Validate via interviews and document review that the vital programs or missions included in Fire Hazards Analyses are correctly identified. Verify via review of the Fire Hazards Analyses that adequate attention has been paid to determining fire protection levels. DOE Orders and standards do not specifically dictate the level of protection required, therefore judgments regarding the acceptability of fire protection levels are at the discretion of the team lead.
4. Validate via interviews and document review that high value property included in FHAs are correctly identified. Verify via review of the Fire Hazards Analyses that adequate attention has been paid to determining fire protection levels. DOE Orders and standards do not specifically dictate the level of protection required, therefore judgments regarding the acceptability of fire protection levels are at the discretion of the team lead.
5. Validate that adequate fire protection is specified via engineering design controls or is currently in place for the following conditions:
  - Automatic suppression for all structures where the Maximum Possible Fire Loss exceeds \$1 Million.
  - Redundant automatic suppression, including redundant water supplies, for all structures where the Maximum Possible Fire Loss exceeds \$50 Million.
  - Redundant automatic suppression plus physical separation via 3-hour fire barriers for all structures where the Maximum Possible Fire Loss exceeds \$150 Million.
  - Automatic suppression is provided in locations housing safety class equipment.
  - Redundant automatic suppression in cases where no redundant capabilities to safety class equipment exist.
  - Automatic suppression for locations housing high value property.
  - Validate that water supplies for fire protection systems have a capacity to support a minimum of two hours of fire suppression plus hose streams. Also validate that underground piping service fire suppression systems is a minimum of 8 inches (nominal) in diameter or proven via hydraulic calculation.
6. Confirm via field inspection and interviews that firewater runoff concerns have been adequately addressed in the Fire Hazards Analyses. Ensure that information in the Fire Hazards Analyses is up to date.
7. Determine if the Contractor has any Halon 1301 fire suppression systems, Halon 1211 fire extinguishers, or other halogenated fire protection systems in Facilities or Areas under

contractual obligation. Verify via interview or document research that the Contractor has a plan for disposition of the systems and/or extinguishers under a timeline agreed upon by the DOE Richland Operations Office Fire Protection Engineer.

**Basis:**

Protection of vital safety systems, safety equipment, mission, property, and the environment are some of the basic objectives of the DOE Fire Protection Program. Utilizing tools, like the FHA the DOE expects the contractor to comprehensively and qualitatively assess the risk from fire within individual fire areas in a DOE facility so as to ensure that these basic fire safety objectives are being met.

**References:**

DOE O 420.1, Contract Requirements Document, Section 4.2  
RLID 420.1, Section 6.2  
RLID 420.1, Section 8.3  
Department of Energy Memorandum, "Managed Phase Out of Halon Fixed Fire Suppression Systems", May 5, 1993.  
[CRD 420.1 Supplemental, Section B 1]

**Interviews:**

As needed to determine implementation.

**Observations:**

Not applicable.

**PROCESS:**

**Records Reviewed:**

- Fire Hazards Analyses:
  - Hughes Associates, Inc., *242-A Evaporator Fire Hazards Analysis*, Westinghouse Hanford Company, Richland, WA, June 1994.
  - SNF-4268, *Fire Hazard Analysis for the Cold Vacuum Drying Facility*, Rev. 1, September, 2000.
  - SD-WM-FHA-019, *Fire Hazard Analysis for Building 225-B Waste Encapsulation and Storage Facility (WESF)*, Rev 1B, December, 1998.
  - HNF-SD-HT-FHA-002, *324 Facility Fire Hazards Analysis*, Rev. 1, March, 2000.
  - HNF-SD-CP-FHA-003, *222-S Laboratory Fire Hazards Analysis*, Rev. 0, August, 1999.
  - HNF-SD-WM-FHA-024, *Fire Hazards Analysis for the 242-A Evaporator*, Rev. 0. September, 1997.
  - HNF-SD-SNF-FHA-002, *Final Fire Hazards Analysis for the Canister Storage Building*, Rev. 2A, April, 2001.
  - HNF-SD-SNF-FHA-001, *Fire Hazards Analysis for the K Basins Facilities at 100 K Area*, Rev. 1A, January, 2002.
  - Hughes Associates, Inc., *242-A Evaporator Fire Hazards Analysis*, Westinghouse Hanford Company, Richland, WA, June 1994.
  - SNF-4268, *Fire Hazard Analysis for the Cold Vacuum Drying Facility*, Rev. 1, September, 2000.

- HNF-SD-CP-FHA-002, Fire Hazards Analysis for the T Plant Complex, Revision 1, June, 2001.
- HNF-SD-HT-FHA-003, *Building 327 Fire Hazard Analysis*, Revision 1, January, 2000.
- Fire Protection Assessments:
  - Barilo, N., *Fire Protection Assessment for Building 324*, March, 2001.
  - Barilo, N., *Fire Protection Assessment for Building 324D*, April, 2001.
  - WMP01-ST-GA-FP-190, *Fire Protection Assessment for T-Plant*, March, 2001.
  - Clarkson, A.W., *Fire Protection Facility Assessment for Building 3621-D*, June, 1996.
  - Clarkson, A.W., *Fire Protection Facility Assessment for Building 6290*, July, 1996.
  - Keene, J. R., *2002 Fire Protection Facility Assessment for the 222-S Laboratory Complex*, June, 2002.
- Safety Basis Documents:
  - HNF-SD-WM-SAR-023, *242-A Evaporator Safety Analysis Report*, Rev. 3-E, Fluor Hanford, Richland, WA, August, 2001.
  - HNF-3553 Annex A, *Spent Nuclear Fuel Project Canister Storage Building Final Safety Analysis Report*, Rev. 1, February, 2002.
  - WHC-SD-WM-SAR-062, *K-Basins Final Safety Analysis Report*, Rev. 3L, December, 1999.
  - WHC-SD-WM-SAR-062, *K-Basins Final Safety Analysis Report*, Rev. 4A, December, 2001.
  - HNF-8659, *K Basin Fuel Transfer System Safety Assessment Project A.15*, Rev. 0, November, 2001.
  - HNF-3553, *Annex B Cold Vacuum Drying facility Final Safety Analysis Report*, Rev. 1C, November, 2001.
  - SD-WM-BIO-002, *Waste Encapsulation and Storage Facility Basis for Interim Operation*, Rev 1B, December, 2001.
  - HNF-SD-SPJ-SAR-001, *324 Building Safety Analysis Report*, Revision 4, April, 2002.
  - HNF-SD-SPJ-SAR-002, *324 Building Safety Analysis Report*, Annual Update, Rev. 2-A, Fluor Hanford, Richland, WA, January, 2001.
- DOE Orders, Documents, Memoranda, Directives:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Department of Energy Memorandum, "Managed Phase Out of Halon Fixed Fire Suppression Systems", May, 1993.
  - Contractor Requirements Document (Supplemented) O 420.1, Change 3 (Revision 0), *Facility Safety*, August, 2001.
- Project Hanford Management Contractor Documents:
  - HNF-8663, *Fluor Hanford Requirements Management*, Revision 0, January, 2002.
- Other Documents:
  - *Hanford Fire Department Quick Access Prefire Plan Building 242-A*, Richland, WA, December, 1999.

- *Hanford Fire Department Quick Access Prefire Plan Building 324*, Richland, WA, December, 2001.
- *Hanford Fire Department Quick Access Prefire Plan Building 225-B*, Richland, WA, December, 2001.
- HNF-RD-9390, *Fire Hazards Analysis Requirements*, Rev. 0, Project Hanford Requirements Document, February, 2002.
- HNF-RD-9391, *Fire Protection Assessments*, Rev. 0, Project Hanford Requirements Document, March, 2002.
- FH-9957237 R5, *Contract No. DE-AC06-96RL13200 – 324 Building Fire Hazards Analysis Related Exemption and Equivalencies*, April, 2000.
- Project W-379, *Spent Nuclear Fuel Canister Storage Building Request for Exemption from the U.S. Department of Energy Order – Automatic Fire Suppression System Requirements*, November, 1996.
- PHMC Halon 1301 Inventory, January 15, 2002.

**Personnel/ Positions Interviewed:**

Project Fire Protection Engineers  
Fire Marshal Fire Protection Engineers  
Facility Representatives

**Evolutions/Operations/Shift Performance Observed:**

Buildings were toured during normal operations.

**RESULTS:**

**Discussion of Results:**

DOE Order 420.1, Section 4.2, establishes the requirements for a comprehensive fire hazards program. Among the parameters that the requirements seek to minimize the potential for are fires that cause a contamination release, interrupt vital DOE programs, excessive property loss, and damage to safety class controls.

The above parameters are collectively grouped under the heading Protection of Safety Equipment, Mission, Property, and Environment in this CRAD. Section 4.2.1 of DOE 420.1 provides some specific design requirements that are targeted at meeting Section 4.2. These requirements include:

- Automatic extinguishing systems in all areas subject to loss of safety class systems or a fire loss potential in excess of defined limits;
- Redundant fire protection systems in areas where safety class systems are vulnerable to fire damage and where no redundant safety capability exists outside the fire area;
- Redundant fire protection systems in areas where the Maximum Possible Fire Loss (MPFL) exceeds DOE limits;
- A means to prevent the accidental release of significant quantities of contaminated products and fire fighting water to the environment; and
- Inadvertent fire protection systems actuation does not interrupt vital safety functions or disable safety class equipment.

DOE Order 420.1 is implemented at the site level via RLID 420.1, *Fire Protection*. Section 8.1 [and CRD (supplemented) 420.1] summarizes the objectives such that DOE O 420.1 is met. Specific criteria listed in Section 8.1 includes:

- Automatic suppression where the Maximum Possible Fire Loss (MPFL) exceeds \$1 million;
- Redundant fire suppression where the MPFL exceeds \$50 million; and
- Redundant fire suppression and 3-hr fire barriers where the MPFL exceeds \$150 million.

Section 8.10 of RLID 420.1 [and CRD (supplemented) 420.1] lists the elements that the Fire Protection Assessments cover, including:

- Fire fighting water runoff;
- Fire protection of safety class equipment;
- Fire protection of high value property.

Section 8.11 of RLID 420.1 [and CRD (supplemented) 420.1] lists the elements that the Fire Hazards Assessments cover, including comprehensive assessment of the risks from fire within individual fire areas. Section 8.11.f requires the FHA and AB documents be consistent and that the FHA address the impact of fire and explosion on essential safety functions. The FHA must also consider protection of Safety Class Components and evaluate the need for separation of redundant systems. Section 8.11.g lists the items the FHA specifically address, including high value property, safety class equipment, and the MPFL/MCFL.

RLID 420.1 and CRD (supplemented) 420.1 are implemented at the contractor level through the Standards/Requirements Identification documentation (HNF-8663) and two requirements documents: HNF-RD-9390 (*Fire Hazards Analysis Requirements*) and HNF-RD-9391 (*Fire Protection Assessment*). Sections 2.1 and 2.2 of HNF-RD-9390 detail the specific areas that the FHA evaluate and includes fire impact to safety class equipment, high value property, and MPFL/MCFL calculations. Similarly, Sections 2.1 and 2.2 identify the areas that the Fire Protection Assessments evaluate. Where facilities do not comply with specific criteria, recommendations may be provided.

In evaluating this CRAD, the following facilities were reviewed:

- Buildings 105 KE and 105KW (K-Basins)
- Building 221-T (T-Plant)
- Building 222-S
- Building 225-B, WESF
- Building 242-A
- Building 324
- Building 327
- Canister Storage Building (CSB)
- Cold Vacuum Drying Facility (CVDF)

The degree to which the prime CRAD objective is met was assessed through document review (FHA, AB documents, prefire plan, *etc.*), personnel interview, and tours of the listed buildings.

Compliance with the primary objective, Protection of Safety Class Equipment, Mission, Property, and Environment, is assessed via the four supporting objectives FP.7.1 through FP.7.4.

The degree to which the supporting objectives are met is evaluated using a combination of document review, personnel interviews, and site surveys. The primary documents that are reviewed for this CRAD include the Fire Hazards Analysis (FHA) and the Authorization Basis (AB) documents such as the Safety Analysis Reports (SARs), Technical Safety Requirements (TSRs), Basis for Interim Operation (BIO), and the Building Emergency Plan (BEP). Secondary documentation includes the building prefire plans, fire protection assessments, DOE memoranda and directives, and other related documents.

### **Supporting Objective FP.7.1**

*Safety class systems are protected in accordance with Department of Energy Orders, codes, and standards.*

This supporting objective is not met because:

- Some FHA and AB documents do not consistently identify safety class equipment;
- In some instances, new projects or FSAR updates added Safety Class Equipment that were not added to the FHA;
- Fire protection requirements for the safety class systems are not specifically addressed in the FHA; and
- The fire impact to the safety class systems is not considered in sufficient depth in the FHA or AB documents.

In most cases, the impact of inadvertent fire suppression system actuation is considered at some level, either directly in the FHA or by the Project Fire Protection Engineers. Safety class items that are primarily structural (steel, concrete based) would clearly benefit from any fire suppression system actuation during a fire. Electronic safety class items inspected had a fail-safe mode that would prevent failure if the suppression system actuated.

Safety class systems are identified in the AB documents. They are usually defined as a subset of those systems, structures, and components (SSCs) that are relied upon to mitigate or prevent the occurrence of an unwanted event or accident with consequences in excess of approved guidelines (Safety SSCs). Safety SSCs are designated in order of increasing importance as General Service (GS), Safety Significant (SS), or Safety Class (SC) in the AB documentation. The Hanford Site interprets the DOE Orders to apply only to SC (or equivalent if another classification system is used) systems. The Safety Equipment List (SEL) or the Important to Safety (ITS) list for each building contains the most current classification of safety related equipment.

### **Alignment Of Safety Class Items In FHA And AB Documents**

The safety class items listed in the FHAs reviewed were not found to be consistent with those identified in the corresponding AB documents. Specific examples include:

- Revision 4a of the Final Safety Analysis Report for the K-Basins lists 26 safety class items in the K-Basins. In addition, the K-Basin Fuel Transfer System Safety Assessment (Project A-15) lists an additional three safety class items. The K-Basins FHA (Revision 1) lists only six, all of which were included in the FSAR.

- The Safety Class list (Table B4-1) in Revision 1C of the Final Safety Analysis Report for the CVDF does not match the safety class components listed in Section 5-2 of the FHA (Revision 1). In particular, the FHA does not list the General Service Helium System or the Cask – MCO components but lists the Safety Significant bay local exhaust, process general exhaust system, and reference air system as well as the General Service bay structure and process water conditioning structure.
- The WESF Basis for Interim Operations (BIO) (Revision 1B) identifies the Area 3 structure, the 296-B stack, and the Area 2 structure as safety class. The FHA does not list these items. The FHA identifies the pool cell Area Radiation Monitors (ARMs) as safety class, whereas the BIO lists them as safety significant. The FHA identifies the pool cell structure and the operating gallery, canyon, hot cell structure as safety class, all of which are part of Area 2 and Area 3, as safety class.

The remaining facilities reviewed either contained no safety class equipment (*i.e.*, T Plant, 222-S, 242-A) or the FHA and AB safety class lists were in agreement (*i.e.*, Building 324). The CSB FHA does not specifically identify the safety class equipment, but it does reference the AB documentation for a complete list. Although the Building 324 FHA and AB documents are in agreement, the building is in the process of changing from a Category 2 to a Category 3 nuclear facility, and the new AB document does not list any safety class equipment or systems for the building. However, the revised safety basis may not require any safety-class structures, systems, or components.

#### Fire Protection And Fire Damage Potential To Safety Class Equipment

DOE Orders require that areas where there is safety class equipment be protected with an automatic fire suppression system. Areas that contain safety class systems or equipment that is vulnerable to fire damage and where redundant safety functions do not exist elsewhere require redundant fire protection.

None of the FHA documents reviewed specifically address this requirement, though some do evaluate the fire impact to the safety class equipment.

The buildings that were used to compile this CRAD fall into one of several categories:

1. The facilities do not have safety class systems and therefore this is not an issue. These facilities include T-Plant, Building 222-S, and Building 242-A.
2. The facilities have safety class equipment but do not necessarily have the proper fire protection. Analysis of the fire exposures to the safety class equipment demonstrates that there is no postulated impact (Building 327) or the equipment could be impacted and some measures are required, such as administrative controls or automatic fire suppression (Building 324, CVDF, WESF).
3. Facilities do not adequately provide automatic fire suppression per DOE Orders and the FHA does not evaluate the potential for fire damage to the equipment. This includes 105 KE, 105 KW, and CSB. In particular, the CSB contains several safety class systems that could be exposed to a combustible liquid pool fire. The CSB FHA refers to the AB documentation for safety class equipment and systems

and does not examine the function or the potential impact of fire on the function. In addition, the operational area has no sprinkler protection (with exemption and administrative controls) and there is the possibility that such a scenario could result in damage or loss of safety function.

In addition, some safety class equipment is located in areas where there is automatic fire suppression, but the FHAs do not fully address inadvertent fire suppression actuation on the system on the equipment. In particular, the CVDF FHA notes that sprinkler actuation may result in spurious signals or malfunctions in safety class equipment. Based on discussions with the building personnel, this equipment is fail-safe, thus this would not be an issue.

### **Supporting Objective FP.7.2**

*Vital programs and missions are protected in accordance with Department of Energy Orders, codes, and standards.*

This supporting objective is met because there are no vital programs or missions at the Hanford site.

There is no clear definition of a vital program or mission. The interpretation used at the Hanford site is that a vital program or mission is any activity related to national defense. Because production of material for national defense purposes is no longer conducted at Hanford, there are thus no vital programs or missions. The FHA and AB documents that were reviewed do not identify vital programs or missions in accordance with the above interpretation. There are no additional fire protection requirements and the supporting objective is thus met.

### **Supporting Objective FP.7.3**

*Property, including high value equipment, is protected in accordance with Department of Energy Orders, codes, and standards.*

The supporting objective is not met because some facilities exceed the DOE loss limitations for the MFPL fire scenarios.

#### **DOE Property Loss Limits**

The following buildings that were reviewed for this CRAD meet the MPFL loss limitations for the fire scenarios that were evaluated:

- 327                      The MPFL is between \$1 million and \$ 50 million. The MCFL is less than \$1 million. The facility has complete sprinkler protection thus satisfying the DOE loss limitations.
- CVDF                    The MPFL is between \$1 million and \$ 50 million. The MCFL is less than \$1 million. The areas considered have complete sprinkler protection thereby meeting the DOE requirements.

- 221-T (T-Plant) The MPFL and MCFL are less than \$1million. There are no DOE loss limitation requirements.
- 2706-T The MPFL is between \$1 million and \$ 50 million. The MCFL is less than \$1 million. The facility has complete sprinkler protection thus satisfying the DOE loss limitations.

The following facilities do not comply with the MPFL loss limitations but address the issue via exemptions, equivalencies, and/or compensatory measures:

- 324 The MPFL is greater than \$ 150 million. The MCFL is less than \$1 million. Per DOE requirements, the facility requires automatic suppression, redundant fire protection, and 3-hour fire barriers. The building requested and obtained an equivalency to the automatic suppression and redundant fire protection and obtained an exemption from the 3-hour fire barrier requirement. The equivalencies are based on administrative combustible controls and increased surveillance of available fire protection systems.
- CSB The MPFL is between \$1 million and \$ 50 million. The MCFL is less than \$1 million. There is no automatic fire suppression in the operational area. The building requested and obtained an exemption for sprinkler coverage using administrative combustible controls as a basis as well as other concerns (contamination spread, criticality concerns, sprinkler efficacy, *etc.*).
- 225-B (WESF) The MPFL is between \$1 million and \$50 million. The MCFL is less than \$ 1 million. The portions of the building where the MPFL is greater than \$1 million have sprinkler protection. Other areas in the building, where the MPFL was previously greater than \$1 million, have an approved exemption from DOE.

The following facilities do not comply with the MPFL loss limitations:

- 105 KE/KW The MPFL is between \$1 million and \$50 million. The MCFL is greater than \$1 million. The facilities do not have complete sprinkler coverage, particularly in the Transfer Area. In addition, sprinklers are not predicted to mitigate scenarios that damage unprotected steel. An open recommendation (FHA-01) provides options, but they have not yet been implemented.
- 222-S The MPFL is between \$50 million and \$150 million. The structure is not protected with automatic fire suppression and does not have redundant fire protection. Open recommendations in the FHA (222S-99-01 and 222S-99-02) call for sprinkler protection in the basement and redundant fire protection systems in areas where there is no fire detection. If the recommendations are addressed, then the facility would be in compliance with DOE loss limitations.
- 242-A The MPFL is between \$1 million and \$50 million. The building has automatic fire suppression throughout. While the FHA states that sprinkler

have not been installed in the HVAC Room, Facility Modification Package HNF-FMP-01-9721-R0, installed per Work Package 2G-01-26274/C, completed 2/28/02, installed sprinklers in this area.

The basis for meeting the DOE loss limitation criteria described above assumes that the fire scenarios evaluated represent the most conservative MPFL events. Refer to the Fire Hazards Analysis CRAD (CRAD FP.6) for discussions of the scenarios covered by the FHA contrasted with what was observed during the building surveys.

#### High Value Equipment

This supporting objective is met because there is no specific protection criteria that is applied to high value equipment.

There is no clear definition of high value equipment in the implementation document nor is there guidance on what type of protective action is necessary when high value equipment is identified. The Hanford Site interprets high value equipment as any item that has a replacement cost that exceeds \$1 million, which is the threshold MPFL value for sprinkler protection. Thus, by default, spaces where there is high value equipment should have sprinkler protection.

The FHA documents that were reviewed adequately identified high value equipment using the most current information at the time the document was issued. In some cases, the values may be obsolete due to the effects inflation or new equipment may have been brought into the facility. This is particularly so where the FHA is not updated frequently, such as Building 242-A (five years) and 222-S (new equipment). Because there is no specific action taken for high value equipment, this is not a significant issue.

#### **Supporting Objective FP.7.3**

*Environmental protection from halogen agents and water runoff from fire protection is adequately addressed.*

This supporting objective is partially met.

#### Contamination Release

The potential for a contamination release (primarily radiological) is adequately addressed in the FHA documents, via the fire scenario development and the MPFL/MCFL calculations. Because the contamination impacts the property loss directly using this approach, the FHAs have a means to provide recommendations that limit the potential for a contamination release. Contamination cleanup costs are gross estimates and vary from document to document. All documents reviewed appeared to be reasonable, however.

#### Halogen Agent Suppression Systems

Environmental protection from halogen agents was promulgated by a DOE directive. Based on interviews with the building Fire Protection Engineers (FPEs) and the Fire Marshal FPEs, it was concluded that the site buildings are aware of this requirement and are making progress toward the elimination of all halogen agent fire extinguishing systems (total flooding). Most facilities do not use or plan to use halogen agent fire extinguishers. Recent interpretation of the halogen agent phase out appears to exempt portable fire extinguishers, thus facilities that use or plan to

use such portable fire extinguishers are not required to phase them out. Only one facility (222-S) was found to have a total flooding system. This system was credited as part of the redundant fire suppression, necessary because the MPFL exceeds \$50 million. The building fire protection engineer indicated that building management does not want to replace the system at this time.

Overall, there are few facilities that have halogen total flooding systems as evidenced by the site inventory provided by the fire department. There is currently no specific plan in place to phase the remaining systems out, but as the processes that the systems protect are decommissioned, the systems are removed from service.

#### Water Runoff

The DOE orders and implementation documents (DOE Order 420.1 and RLID 420.1) indicate that the FHA or other assessment documents should determine what features (*i.e.*, curbs, dikes, *etc.*) are necessary to mitigate the contamination spread by water runoff. The contractor level documents (HNF-RD-9390) require the FHA to address this issue only if the fire protection assessment does not.

The site interpretation of the water runoff requirements is that they apply to situations where the water could leave the site, not a particular building. A sampling of Fire Protection Assessment documents found that this issue is addressed in these documents. The assessments note when water runoff from a contaminated facility is possible and, reflecting the site interpretation of the runoff issue, do not recommend mitigation strategies. An exception to this is the CVDF, which has a containment tank for fire fighting water runoff.

Some FHA documents that were reviewed identify the issue (containment of liquids) and calculate the volume of water that would be discharged from the sprinkler system and/or fire fighting hose streams. The FHAs that identify the issue may or may not draw any conclusions or provide recommendations. The FHAs do not estimate the water retention capacity of the particular building and do not state that the calculated volume could leave the building as runoff and be absorbed by the ground. As a minimum, the FHAs should include statements that indicate that the calculated quantity of water could be assumed the runoff volume and there may be some ground contamination.

The following were also noted:

- There is an inconsistent sprinkler/hose stream duration listed in the FHA documents. While there is no explicit requirement on how water run off is calculated as per RLID 420.1 and DOE 420.1, the water volume calculation should be based on either a two-hour or four-hour water flow duration depending on the nature of the facility:
  - The 242-A FHA assumes 20-minutes;
  - K-Basins implies four-hours; and
  - WESF and 222-S do not use a duration.
- The FHAs do not consistently include hose streams allowances:
  - 242-A and 222-S do not include a hose stream allowance;
  - It could not be determined if a hose stream allowance was included for the K-Basins, WESF.

- The sprinkler/hose stream demand in the FHAs and the prefire plans are not consistent:
  - 242-A prefire plan lists a maximum demand of 2800 gallons per minute (gpm); the 242-A FHA uses a 1,250 gpm sprinkler system demand (no hose stream allowance).
  - K-Basins prefire plan lists a total demand of 460 gpm; the FHA identifies a maximum 1,123 gpm flow.
  - WESF prefire plan lists a total demand of 450 gpm; the FHA identifies a flow requirement of 1,210 gpm.
  - Building 324 prefire plan lists a maximum demand of 5468 gpm; the FHA identifies the maximum fire suppression requirement as 3500 gpm, or 4100 gpm with the potable water demand included.

The FHA documents and the prefire plans use different assumptions and calculation procedures for determining the water demand. However, the FHA calculates the demand in order to assess the adequacy of the delivery system. As shown above, the prefire plans often postulate a greater demand than the FHA. Disparities in the hose stream requirements creates confusion as to what the actual hose stream demand is and whether or not the water supply is capable of supplying the hose stream demands. Disparities in the hose stream requirement creates confusion as to what the actual hose stream demand is and whether or not the water supply is capable of supplying the hose stream demands.

### **Conclusion:**

Protection of safety equipment, vital missions and equipment, property, and the environment is implemented at the facility level in a variety of ways. The AB documentation identifies the accident scenarios and the required safety class equipment and systems necessary to limit the consequences; the FHA and to a lesser extent the fire protection assessments are responsible for evaluating the impact of a fire to the safety class equipment. Deficiencies should be identified in the FHA and recommendations that correct these deficiencies provided. This is not always the case as discussed above.

Identification of property that is vulnerable to fire exposures is primarily done in the FHA and fire protection assessments. In most cases, the property loss is within limitations or exemptions from DOE have been granted. Some buildings were identified that do not comply with loss limitations, but the FHA provided recommendations for upgrades or exemption requests. These recommendations were open at the time of this evaluation. In isolated instances, buildings were not in compliance with loss limitations and no corrective action was recommended by the FHA, though it appeared that there may be grounds for an exemption.

The environmental concerns that were considered in this analysis are fire fighting water runoff and replacement of halogen agent suppression systems. Fire fighting water runoff is addressed in the fire protection assessments. In many cases, the assessments concluded runoff could occur. As a minimum, some consideration for ground contamination via water runoff should be made in the FHA and if there is a potential for significant runoff, some control may be warranted. Based on discussions with fire protection engineers in the fire marshals office, there is an active program for replacing halogen agent total flooding systems. Only one facility toured had such a system and there was no specific plan in place to replace it. Halogen agent portable fire extinguishers were not found during the tour, though one facility intended on obtaining them for installation in a crane.

This CRAD is not considered to be met because the FHA documents do not evaluate the impact of various fire scenarios to safety class equipment or the safety class function as required by RLID 420.1 Section 8.11f.1.(f) [and CRD (supplemental) 420.1] and HNF-RD-9390, Section 2.2. Per DOE Orders 420.1 and RLID 420.1 [and CRD (supplemented) 420.1], certain protection measures are necessary depending on the nature of the safety class function (redundant or otherwise). The FHA documents are not consistent in identifying this level of protection. Consequently, although several supporting objectives within the CRAD are satisfactorily met, the most significant aspects are not. Thus, it is concluded that this CRAD is not met.

**Issues:**

1. Protection of safety class equipment from fire exposures is not adequately addressed in the FHA. The FHA documents do not discuss the safety class function that is required and the potential impact of a fire (or fire protection systems) on the safety function. Where there is the potential for damage to this equipment or these systems, the FHA should provide recommendations for mitigation. This needs to be coordinated with the AB documents. The FHAs do not adequately address Section 4.2.1 of DOE 420.1 with respect to the Safety Class equipment.
2. DOE loss limitations are not completely addressed in the FHA documents. There are examples where the FHA identifies scenarios that exceed recommended loss limitations and provides recommendations, but the recommendations remain open.
3. The water supply (demand) is not consistent between the Fire Hazards Analysis (FHA) and the prefire plans. Cases are identified where the difference is significant (more than 50 percent). The FHA and prefire plans inherently use different assumptions for determining the maximum water demand. The FHA calculation is performed to assess the adequacy of the water delivery system and should thus be the bounding value. In some instances, the prefire plan water demand estimates are significantly greater than the estimates in the corresponding FHA documents. This observation is not directly related to the subject of this CRAD and was not fully investigated. Disparities in the hose stream requirement creates confusion as to what the actual hose stream demand is and whether or not the water supply is capable of supplying the hose stream demands.

## **Life Safety Considerations**

### **Objective FP.8 – Life Safety Considerations**

The Contractor demonstrates adequate life safety practices.

**Supporting Objective FP.8.1.** Life safety provisions are being implemented in new construction project.

**Supporting Objective FP.8.2.** Life safety provisions are being maintained in existing structures.

**Supporting Objective FP.8.3.** Special life safety provisions are incorporated into designs in locations that have explosive or hazardous atmospheres.

#### **Criteria:**

1. The Contractor requires implementation of NFPA 101, *Life Safety Code* in new Facility or Area projects.
2. The Contractor enforces NFPA 101, *Life Safety Code* in existing buildings and in renovations of existing buildings.
3. The Contractor demonstrates knowledge of resources or alternative methods of determining adequate egress under special hazard conditions.

#### **Approach:**

1. Validate that the Contractor's Fire Protection Program and/or Engineering practices manual dictates the use of NFPA 101 is both new and renovated Facilities or Areas under contractual obligation.
2. Obtain copies of several projects (number and type as determined by the team lead). Review the projects using against NFPA 101 to determine that adequate attention has been paid to life safety.
3. Review inspection reports and interview inspection personnel (like the Fire Protection Engineer for the project) to determine the extent to which life safety infractions occur. Ensure that the number and frequency of infractions is low (as determined by the team lead) and that timely correction of the concerns is performed. Tour Facilities and Areas under contractual obligation to the Contractor (number and location as specified by the team lead) to field verify compliance conditions. Particular attention should be paid to exit signs, emergency lighting, obstructions to egress, door swings and ease of opening, and violation of fire barriers defined for life safety (generally stairs, shafts, horizontal exits, etc.).
4. Interview Contractor Fire Protection Engineers to verify knowledge of special hazard (radiation, explosives, etc.) life safety needs and resources for additional or alternate egress requirements. Specific mention of NFPA 101A and the DOE Explosives Safety Manual should occur.

#### **Basis:**

Life safety is amongst the most important concepts in fire protection philosophy. Although DOE Orders, codes, and standards require the use of NFPA 101, basic life safety requirements are the hallmark of every building and fire code used in the United States. The need to implement a specified level of life safety is necessary to ensure egress under fire conditions, and maintaining that level of safety beyond original construction is an inherent necessity.

**References:**

DOE O 440.1, Contract Requirements Document, Section 15  
RLID 420.1, Section 6.2 d  
RLID 420.1, Section 6.2 t  
RLID 420.1, Section 8.16  
[CRD 420.1 Supplemental, Section C 2]

**Interviews:**

As required.

**Observations:**

None.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August 2001.
  - Occurrence Report, ORO--MMES-Y12DEFPGM-1993-0093, Defective Emergency Lighting.
- Site Wide Documents:
  - HNF-PRO-1819, Rev. 7, *PHMC Engineering Requirements*, 11/06/01.
  - HNF-8002, Rev. 2, *Engineering, Procurement, and Construction Process Management Plan*, 01/14/02.
  - HNF-RD-9118, Rev. 0, *Fire Protection Design/Operations Criteria*, 12/21/01.
  - HNF- RD-9717, Rev. 1, *Fire Prevention for Construction/Occupancy/Demolition Activities*, 4/29/02.
  - HNF-PRO-1997, Rev. 5, *Project Management for Construction – Overview*, 10/16/01.
  - HNF-PRO-1999, Rev. 2, *Project Management for Construction - Conceptual Phase*, 06/15/00.
  - HNF-PRO-2000, Rev. 2, *Project Management for Construction - Execution Phase*, 10/16/01.
  - HNF-PRO-2001, Rev. 1, *Facility Modification Package Process*, 11/06/01.
  - HNF-RD-8589, Rev. 1, *Hanford Fire Marshal Permits*, 3/21/02.
  - HNF-RD-8635, Rev. 1, *Review of Technical Documents*, 06/14/02.
  - HNF-IP-1264, Rev. 3, *324/327 Facilities Stabilization Projects Administrative Manual – Fire Protection*.

- Contractor Documents:
  - Hanford Fire Marshal Permit System (electronic, web-based at <http://apweb02.rl.gov/firepermit/index.cfm>)
  - LO-040-101, Analytical Services 222-S Complex Building Inspection, Rev/Change No. R-2
  - EO-040-002, Waste Encapsulation and Storage Facility (WESF), Perform General Surveillance, Rev/Change G-7
  - MS-1-23-05, *Approval Designators*
  - SP-20-001E, Monthly Egress Light Test – 100KE, Revision 6
  - SP-20-002E, Annual Egress Light Test – 100KE, Revision 6
  - OP-06-002 W, Perform Routine Rounds At 105-KW, Rev 14
  - OP-06-002W, Rev 14/B K West Round Sheet
  - OP-06-001E, Perform Routine Rounds At 105-KE, Rev 8
  - OP-06-001E, Rev 8 K East Round Sheet
  - DO-040-016, Treatment Facility Perform Weekly and Daily Surveillance of Waste Management Areas, Rev/Change F-1
  - DO-040-004, T Plant Operating Procedure Perform Surveillance of Treatment Facility Emergency Equipment, Rev/Change D-4
  - ECN-654799: 225 B/C12P/2C (Provide emergency lighting for WESF Pool Cells)
  - 324 Facility Maintenance Preventive Maintenance Procedure 3I22003, Rev. 2, Change 0,
  - Preventive Maintenance of Emergency and Exit Lights, April 29, 2002.

**Personnel/ Positions Interviewed:**

Fluor Hanford Fire Marshal  
Fire Protection Engineers (Fire Marshal's Office)  
Fire Protection Engineers (Contractor)  
242-A Evaporator Facility Fire Protection Design Authority  
WESF Fire Protection Design Authority  
WESF Facility Manager

**Evolutions/Operations/Shift Performance Observed:**

None.

## **RESULTS:**

### **Discussion of Results:**

#### **Supporting Objective FP.8.1**

*Life safety provisions are being implemented in new construction projects.*

Site level engineering documents require that design inputs be adequately identified prior to design commencing. HNF-RD-9118, *Fire Protection Design/Operations Criteria*, requires that National Fire Protection Association (NFPA) codes and standards be followed for all fire protection designs, modifications, upgrades, and other fire protection related activities. This includes the requirements of NFPA 101, Life Safety Code.

This requirement is being implemented at the Project and facility level. Interviews with Fire Protection Engineers and Design Authorities indicate adequate involvement of fire protection engineers in the review of facility modification packages to ensure an adequate level of life safety is provided.

Fire protection design authorities interviewed expressed a very good working relationship with the respective Fire Protection Engineer assigned to the facility. Appropriate life safety reviews appear to be obtained in accordance with Site procedures (See CRAD FP.3 for more information).

#### **Supporting Objective FP.8.2**

*Life safety provisions are being maintained in existing structures.*

In evaluating this CRAD, the following facilities were reviewed:

- Buildings 105 KE and 105KW (K-Basins)
- Building 221-T (T-Plant)
- Building 222-S
- Building 225-B, WESF
- Building 242-A
- Building 324
- Building 327
- Canister Storage Building (CSB)
- Cold Vacuum Drying Facility (CVDF)

Life safety elements observed during facility tours included exit signs, emergency lighting, obstructions to egress, door swings and ease of opening, and violation of fire barriers necessary for life safety (stairs, shafts, horizontal exits, etc.).

While life safety provisions are generally maintained in existing structures, the following observations/issues were identified during the facility tours:

- Numerous battery-powered emergency lighting units in Building 105 KW were observed to have misaligned lamps (aimed at walls, ceilings, or other obstructions). It was reported that the shift operators perform daily checks of the units and that electricians perform monthly and annual preventive maintenance. The proper alignment of the emergency lighting lamps is checked during the preventive maintenance checks but not during the daily checks by the shift operators.

Both the monthly and annual egress light test procedures include a requirement to reposition the lamps as necessary to provide sufficient illumination for safe exit.

- OP-06-002W, Rev 14/B and OP-06-001E, Rev 8 contain entries on the round sheets for emergency lighting: "Test emergency lighting". This is accomplished on a daily basis. However, the procedures OP-06-001E, Perform Routine Rounds At 105-KE, Rev 8 and OP-06-002 W, Perform Routine Rounds At 105-KW, Rev 14 do not mention emergency lighting checks.
- LO-040-101, Analytical Services 222-S Complex Building Inspection, Rev/Change No. R-2 includes checking for burned out light bulbs but does not specifically mention emergency lighting checks such as lamp orientation.
- Two areas in Building 327 did not have adequate emergency lighting: the west side of the SERF room did not have emergency lighting and the emergency lighting unit on the east side of the BURST room was blocked by the storage of manipulators.
- Exit signs in Building 327 direct persons through an exit door in the middle of the north exterior wall of the building. The access route passes through an overhead roll-up door, which is in violation of NFPA 101. More importantly, the Facility Manager stated that the overhead door is closed when the canyon area goes on mask. Although there appeared to be adequate egress capacity available from other areas of the building with this door closed, the elimination of this exit with the overhead door closed did not appear to have been previously considered.
- Emergency lighting within facilities did not appear able to meet NFPA 101 performance requirements of to provide initial illumination that is not less than an average of 1 ft-candle (10 lux) and, at any point, not less than 0.1 ft-candle (1 lux), measured along the path of egress at floor level. While emergency lighting units appear to be individually tested, lighting performance throughout the required areas does not appear to be adequate in a number of facilities observed (e.g. T-Plant, 105KW transfer bay, 324). A qualitative test in many of these windowless structures might be prudent to ensure employee safety during a fire or electrical outage. The concerns regarding emergency lighting are borne out of experience at multiple DOE Sites. In particular, an emergency lighting deficiency was discovered at an Oak Ridge facility, and is summarized in Occurrence Report, ORO-MMES-Y12DEFPGM-1993-0093, *Defective Emergency Lighting* as follows:

*During a routine scheduled power outage for Building 9201-5, a safety evaluation of the building emergency lighting and "EXIT" signs detected notable deficiencies. These deficiencies consisted of the following: no emergency lighting provided in several areas, failure of emergency lighting to operate during the power outage, inadequate emergency*

*lighting in some areas, and emergency lighting blocked by temporary storage of materials.* These identified deficiencies are similar to issues identified in this assessment.

- WESF should be recognized for proactively identifying inadequacies in the emergency lighting system and initiating upgrades to correct the problem: ECN-654799: 225 B/C12P/2C (Provide emergency lighting for WESF Pool Cells)

### **Supporting Objective FP.8.3**

*Special life safety provisions are incorporated into designs in locations that have explosive or hazardous atmospheres.*

None of the areas toured contained high-hazard areas as defined by NFPA 101. Special hazard (radiation, explosives, etc.) life safety needs and resources for additional or alternate egress requirements were discussed with the Fire Protection Engineers as part of this assessment. NFPA 101A and the DOE Explosives Safety Manual were discussed.

#### **Conclusion:**

Life safety considerations such as exit signs, obstructions to egress, door swings and ease of opening, and violation of fire barriers necessary for life safety (stairs, shafts, horizontal exits, etc.) are adequately addressed throughout the facilities.

However, it appears that the issue of emergency lighting is inconsistently addressed. Based on some responses and facility tours it appears as if the mere presence of an emergency lighting unit is offered as compliance with emergency lighting illumination levels. Operational testing of individual battery-powered emergency lighting units is performed to ensure the unit operates. However, no documentation exists that demonstrates performance testing of the system was performed to ascertain, whether qualitatively or quantitatively, that adequate lighting levels are achieved. The one exception noted during this assessment was WESF. WESF has identified inadequacies in the emergency lighting system. An engineering change notice to upgrade the lighting in the facility is in place.

One issue concerning egress through an overhead door was observed in Building 327. Although an isolated incident based on this assessment, it does warrant mentioning due to the potential impact to egress and the apparent lack of review.

NFPA 101 requirements are implemented into facility designs. A minimum of two paths of protected egress out of facilities was generally observed, travel distances appeared to not be exceeded, and exit signs at the appropriate places were provided. Unique fire protection features of the life safety code, such as sprinkler protection and emergency fire alarm systems were also provided in most facilities. With the exception of the overhead door and the emergency lighting issues the criteria, review and approach elements of life safety were met.

#### **Issues:**

1. Numerous emergency lighting unit lamps within Building 105 KW were observed to be misaligned. Proper alignment of lamps is contained in the monthly and annual preventative maintenance. However, the procedure to conduct routine rounds of the facility does not include a check for proper lamp alignment. Isolated incidents of misaligned lamps were

observed in other facilities as well. This could be indicative of a lack of knowledge on the part of inspection personnel as to what should be checked or procedural inadequacies.

2. Based on interviews with Fire Protection Personnel, performance testing of emergency lighting illumination levels has not been performed. During the facility tours it was noted that the locations/spacing of battery-operated emergency lighting units in a number of cases appeared inadequate for the performance for the overall emergency lighting system. While emergency lighting units appear to be individually tested, lighting performance throughout the required areas does not appear to be adequate in a number of facilities observed (e.g. T-Plant, 105KW transfer bay, 324). A qualitative test in many of these windowless structures might be prudent to ensure employee safety during a fire or electrical outage. Although procedures are in place to perform preventive maintenance and operational checks of emergency lighting units, this does not include an assessment of the adequacy of lighting levels. A similar issue was identified at another DOE site, which resulted in the discovery of inadequate illumination (see Occurrence Report, ORO--MMES-Y12DEFPGM-1993-0093, *Defective Emergency Lighting*).
3. Exit signs in Building 327 direct persons through an exit door in the middle of the north exterior wall of the building. The access route passes through an overhead roll-up door, which is in violation of NFPA 101. More importantly, the Facility Manager stated that the overhead door is closed when the canyon area goes on mask. Although there appeared to be adequate egress capacity available from other areas of the building with this door closed, the elimination of this exit with the overhead door closed did not appear to have been previously considered.

## **Fire System Operability**

### **Objective FP.9 – Fire System Operability**

The Contractor has an adequate inspection, testing, and maintenance (IT&M) program and a method for impairing of fire systems.

**Supporting Objective FP.9.1.** The Contractor has procedures for performing inspection, testing, and maintenance of fire protection systems.

**Supporting Objective FP.9.2.** The Contractor has an inventory of fire protection systems within its facilities and has a schedule for performing inspection, testing, and maintenance of the fire protection systems.

**Supporting Objective FP.9.3.** The Contractor has a record of successfully completed inspection, testing, and maintenance of fire protection systems within Facilities or Areas for which the Contractor is contractually obligated.

**Supporting Objective FP.9.4.** The Contractor has a method of identifying concerns generated during inspection, testing, and maintenance activities to facilitate immediate or near-term correction.

#### **Criteria:**

1. Procedures are developed and in place for performing inspection, testing, and maintenance on fire protection systems and equipment.
2. Inspection, testing, and maintenance are performed, as required by national codes and standards, on each fire protection system within Facilities or Areas under contractual obligation by the Contractor.
3. Inspection, testing, and maintenance are performed on the frequency specified by national codes and standards as dictated by the contract between the Contractor and the Department of Energy.
4. The Contractor keeps and maintains records for the completion of inspection, testing, and maintenance on fire protection systems.
5. A process or method has been established to facilitate identification of concerns with fire protection systems during inspection, testing, and maintenance.
6. A process or method is in place to impair fire protection systems and to implement corresponding compensatory measures.
7. A process is in place to facilitate immediate or near-term correction of concerns with fire protection systems.

#### **Approach:**

1. Obtain a copy of the Contractor's last self-assessment of the inspection, testing, and maintenance program. Review the assessment for any identified deficiencies or concerns.
2. Obtain a listing of procedures used by the Contractor to perform inspection, testing, and maintenance on fire protection systems. If the Contractor utilizes assistance outside their respective corporation (i.e., another Contractor organization or external sub-contract company), obtain a copy of the contractual agreement between the two organizations. Request a sampling of procedures (the type and number are at the discretion of the team lead) for review to ensure that requisite contractually obligated Orders, codes, and standards for the performance of the inspection, test, or maintenance is met.
3. Determine if the Contractor maintains a listing of the fire protection systems within their Facilities or Areas. Also determine if the Contractor maintains a schedule for inspection, testing, and maintenance of fire systems. Based on the available information, ensure the requisite contractually obligated Orders, codes, and standards for frequency of the inspection, test, or maintenance are met.
4. Request inspection, test, and maintenance records (the type and number at the discretion of the team lead) for facilities of interest under the contractual obligation of the Contractor. Match the available records to the procedure listing in Item 2 above to ensure that adequate record keeping is being performed to prove operability of fire systems and equipment.
5. Verify that the Contractor has or follows a Site approved fire system improvement program. Request a copy of the program for review and validation of adequacy, based on professional judgment. Field verify, via record review and interviews, that the program is being followed by the Contractor.
6. Interview Contractor personnel - preferably multiple individuals to include IT&M technicians, facility managers, fire protection engineers, and work control personnel – to determine the path toward correction of concerns raised during inspection, testing, and maintenance activities. Ensure, based on the opinion of the team lead, that timely identification and correction of concerns is being achieved.

**Basis:**

Continued inspection, testing, and maintenance, as well as the control of impairments, achieves the baseline goal of determining operability of fire systems, as required by RLID 420.1, Section, 8.12 [CRD 420.1 Supplemental, Section C 3]. Inspection, testing, and maintenance of fire protection systems are important aspects of ensuring continued operability. DOE Orders commit to the use of national codes and standards (predominantly those of the National Fire Protection Association), which in turn require that installed fire protection systems be maintained. Since fire protection systems are relied upon for life safety, firefighter safety, property protection, minimization of spread of hazardous materials, and a host of other safety concerns, continued operation in a reliable manner is highly desired. Confirm that procedures exist, that the procedures meet the national codes and standards, that the frequency of the IT&M meets expectations, and that adequate record-keeping are necessary elements in ensuring that operability can be proven. Control of impairments to systems, to allow for initiation of adequate compensatory measures, provides an element of improved-risk philosophy.

**References:**

DOE O 420.1, Contract Requirements Document, Section 4.2.2

RLID 420.1, Section 6.2 q

RLID 420.1, Section 8.12

“Guidance for the Quality Assurance of Fire Protection Systems”, Department of Energy, October 1994.

[CRD 420.1 Supplemental, Section C 3]

**Interviews:**

Interviews as needed to verify compliance.

**Observations:**

Not applicable.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August 2001.
  - DOE Richland Office Memorandum 96-QSH-068, “Hanford Site Implementation Of National Fire Protection Association (NFPA) 25”, 9/25/96.
  - DOE Richland Office Memorandum 01-ESD-014, “Contract No. DE-AC06-96RL13200 – Approval Of Hanford Fire Protection Forum (HFPF) Equivalency Request For National Fire Protection Association (NFPA) 72, National Fire Alarm Code Inspection And Testing Requirements”, 10/19/00.
- Site Wide Documents:
  - HNF-8663, Rev. 0, *Fluor Hanford Requirements Management Functional Area Document*, Section 12, *Fire Protection*, 1/22/02.
  - HNF-RD-7899, Rev. 1, *Fire Protection System Testing/Inspection/Maintenance/Deficiencies*, 4/11/2002.
  - HNF-PRO-052, Rev. 7, *Corrective Action Management*, 6/7/01.
  - HNF-IP-0939, Section 3.2, Rev. 2, *Fire Protection System Discrepancies*, 1/6/00.
  - HNF-IP-0939, Section 17.1, Rev. 3, *End Of Month Statistical Data For Graphs*, 2/10/99.
  - HNF-IP-0939, Section 17.2, Rev. 2, *Fire System Impairments*, 2/10/99.
  - HNF-IP-0939, Section 17.3, Rev. 5, *Fire System Testing And Maintenance Program Plan*, 11/15/01.
  - HNF-IP-0939, Section 17.4, Rev. 0, *Panel Operating Procedure Administration*, 8/16/00.
  - HNF-IP-0939, Section 17.5, Rev. 2, *Fire System Installations/Modifications/Deactivations*, 6/21/01.
  - HNF-IP-0939, Section 17.8, Rev. 2, *Control of Fire System Deactivation*, 12/20/00.
  - HNF-IP-0939, Section 17.10, Rev. 5, *Fire System Testing & Maintenance Procedure Administration*, 3/23/01.
  - HNF-IP-0939, Section 17.11, Rev. 2, *Work Management*, 1/31/01.

- HNF-IP-0939, Section 17.12, Rev. 0, *Controlling Work "By Others" in Hanford Fire Department Facilities*, 3/13/01.
- HNF-5828, Rev. 0, *Hanford Site Water System Master Plan*, 9/00.
- Project Hanford Management Contractor Documents:
  - Project Hanford Lessons Learned 2002-RL-HNF-0003, *Water Supply to WRAP Facility Lost*, 1/17/02.
  - *Comprehensive Fire Safety Review: The Hanford Site*, 10/01.
  - *Hanford Fire Department Needs Assessment and Master Plan*, 6/02.
- Facility Rounds, Inspections, and Related Documentation:
  - FS0001, Rev. 0, Change D, *Shotgun Valve Maintenance*, 6/2/98.
  - FS003-1A, Rev. 0, Change 0, *Annual RFAR Functional Testing & Periodic Maintenance*, 4/09/02.
  - FS0010, Rev. 1, Change A, *Test and Maintenance of Fire Alarm Control Panel (FACP)*, 5/24/99.
  - FS0011, Rev. 1, Change A, *Fire Extinguisher*, 11/23/98.
  - FS0014, Rev. 1, Change 0, *12 Month Functional Test of Deluge/Preaction Fire Riser with Electrical or Dry Pilot Release*, 12/19/97.
  - FS0019, Rev. 1, Change C, *12 Month Functional Test of Dry Fire Riser*, 4/26/99.
  - FS0023, Rev. 1, Change 0, *Perform Hydrant Flow Test*, 4/1/99.
  - FS0041-B, Rev. 0, Change 0, *Heat Detector Testing in 225-B Manipulator Cells*, 6/20/01.
  - FS0043, Rev. 0, Change B, *Test and Do Maintenance on Fire System Anti-Freeze Loops, Drip Drums, & Low Point Drains*, 4/10/98.
  - FS0049, Rev. 1, Change B, *Replace FACP Batteries*, 3/13/00.
  - FS0057, Rev. 0, Change B, *Annual Testing and Maintenance on VESDA Smoke Detection Control Panel*, 5/24/99.
  - FS0061, Rev. 0, Change 0, *Fire Rated Door and Barrier Inspection for HFD Facilities*, 9/11/97.
  - FS0107, Rev. 0, Change 0, *Emergency Light Inspections*, 2/24/99.
  - Completed inspection, testing, and maintenance reports held by HFD Fire Protection System Testing and Logistics personnel.
  - EO-040-002, *Waste Encapsulation and Storage Facility (WESF) Perform General Surveillance*, Revision/Change G-7, 5/02.
  - FP-4-014-002, *Spent Nuclear Fuel Project Fire Protection Program*, Rev 2, (Page Change B), 5/01.
  - HNF-IP-1264, *324/327 Facilities Stabilization Projects Administrative Manual*, Revision 3, 3/02.
  - OP-06-002W, *Perform Routine Rounds at 105-KW*, Revision 14, 5/02.
  - OP-06-002W, *K West Round Sheet*, Revision 14, 5/02.
  - OP-06-001E, *Perform Routine Rounds at 105-KE*, Revision 8, 5/02.
  - OP-06-001E, *K East Round Sheet*, Revision 8, 5/02.
  - DO-040-016, *Treatment Facility Perform Weekly and Daily Surveillance of Waste Management Areas*, Revision/Change F-1, 10/00.
  - DO-040-004, *T Plant Operating Procedure, Perform Surveillance of Treatment Facility Emergency Equipment*, Revision/Change D-4, 1/02.
  - LO-040-101, *Analytical Services 222-S Complex Building Inspection*, Revision 2, 5/02.

- Other Documents
  - INEEL Lessons Learned 2001-209, *Inspections/Flushes of Fire Protection System Piping Reveal Debris*, 9/13/01.
  - DNFSB 2000-2 *Phase II Assessment Report of the Central Waste Complex Fire Protection Systems*

(Note: Document and record reviews occurred during both this assessment effort and the Hanford Fire Department Needs Assessment effort by the assessing Team Member.)

**Personnel/ Positions Interviewed:**

Project Fire Protection Engineers  
Fire Marshal's Office Fire Protection Engineers  
Fire Protection Systems Testing and Logistics Leads  
Fire Protection Systems Maintenance Leads  
Facility Operations Managers  
Water Plant Manager  
Hanford Water Purveyor

(Note: Some interviews for this CRAD were performed during the Hanford Fire Department Needs Assessment by the assessing Team Member.)

**Evolutions/Operations/Shift Performance Observed:**

None.

**RESULTS:**

**Discussion of Results:**

DOE Order 420.1 provides requirements for inspection, testing, and maintenance of fire protection systems to ensure operability. Section 4.2.1.2 requires a:

*Comprehensive, written fire protection criteria that reflect additional site-specific aspects of the Fire Protection Program, including...requirements for the design, installation, operability, inspection, maintenance and testing of fire protection systems.*

Further, RLID 420.1, Section 6.2.q requires that the Contractor:

*Ensure that fire protection systems and features are inspected, tested, and maintained in accordance with the applicable NFPA standards or as in approved exemption/equivalency requests as supplemented by this Directive in each facility.*

The supplemented CRD O420.1 provides requirements for Contractors to provide appropriate fire protection system inspection, testing, and maintenance for fire alarm and fire suppression systems.

At the Hanford Site, inspection, testing, and maintenance of fire protection systems is performed, primarily, by the HFD. By a combination of directive and contractual means, the HFD's Fire Protection System Testing and Logistics and Fire Protection Systems Maintenance organizations

have the largest responsibility for implementation of the fire protection system operability portion of the Fire Protection Program. These organizations are responsible for the active fire protection systems (automatic sprinklers, detection systems, gaseous fire suppression systems, *etc.*) within Fluor Hanford, Inc. These organizations also provide inspection and testing services for some systems beyond those that directly support the Hanford Fire Department and their facilities. Other responsibilities include inspection, testing, and maintaining a variety of self-contained breathing apparatus (SCBA) and positive air pressure respiratory systems (PAPRS).

Those systems not tested by the HFD groups are the responsibility of individual facility owners. Passive fire protection systems (fire barriers, walls, doors, *etc.*), life safety devices (emergency lights, egress door mechanisms, exit signs, *etc.*), and some active system inspections and tests (*e.g.*, monthly gauge readings and valve alignments on sprinkler systems, freeze protection, and fire pump start features) are within the duty of facility owners.

HNF-8663, Chapter 12 recognizes the requirements outlined above for inspection, testing, and maintenance of fire protection systems. The basic requirements for the program are outlined in HNF-RD-7899, which includes a table that specifies the required inspection, testing, and maintenance to be performed for each type of system, along with the required frequency. The table in HNF-RD-7899 identifies various National Fire Protection Association (NFPA) documents as the core requirement for the inspection, test, or maintenance items, however the items are related to two alternative compliance plans developed by the Fire Protection Forum. One plan is for fire suppression systems, based primarily on NFPA 25 and other NFPA documents, and the other is for NFPA 72, which pertains to fire alarm systems. In combination, the two documents make up the bulk of the requirements under the program.

During preparations for the HFD Needs Assessment, the Team developing that document reviewed the training and education of a cross-section of the personnel in the HFD. The personnel, in general, were found to be highly trained for their respective positions and conducted themselves professionally in the field. As a particular point, the personnel recognized that the systems they are responsible for benefit responding firefighting forces as much as they do the facility in which they are installed. Given the weight that the Needs Assessment document gives to installed protection systems to justify baseline personnel numbers, such recognition is a key factor to the overall program at Hanford.

### **Supporting Objective FP.9.1**

*The Contractor has procedures for performing inspection, testing, and maintenance of fire protection systems.*

The process for inspection, testing, and maintenance of active fire protection systems is proceduralized by the HFD organizations. Procedures both generic and specific are available, depending on the specific task at hand. A number of the procedures were randomly selected and reviewed (as referenced above). The procedures were considered complete, although they do require a certain amount of job skills and knowledge. Given the previous review of the training and education of the personnel, this is considered an acceptable condition.

Specific procedures are not, in general, available for those tasks that are assigned to facility management. A variety of recognized methods are, however, used. As an example, inspection

of egress lighting and exit signage is performed in most facilities using round sheets. Depending on the facility, the round sheets range from those dedicated to a particular item or system (e.g., valve line-ups) or can be included in a broader scope of items (e.g., fire extinguisher checks are often combined with other monthly inspection items).

For those items that actually require “work”, such as fire door testing, work packages are typically generated and tracked via work control systems. Electronic tracking systems are used by the various Projects to identify when an inspection or test item is required to be performed, and provides linkages to generate work packages or inspection sheets. These systems can then be used to backtrack and regenerate closure information should a need arise.

While not the most user-friendly, the practices used by the individual facilities do provide a proceduralized methodology for the equipment and systems under their responsibility. As is indicated below, these practices do appear to work and ensure that the required inspections, tests, and maintenance are being performed on the schedules indicated in HNF-RD-7899.

Two areas of concern have been raised from reviewed materials that have application to this assessment. One deals with the adequacy of continuing maintenance of water supplies and the other has to do with obstruction investigations in fire sprinkler systems.

The concern regarding obstructions in fire sprinkler systems arises from an identified issue at Idaho National Engineering and Environmental Laboratory (INEEL). INEEL LL 2001-209 indicates that at least three fire protection systems were found to have conditions that caused leakage or obstruction of the piping. Because of the system configurations and testing protocols, these conditions were not found until an internal examination of the piping was undertaken. At Hanford, internal piping inspections are not undertaken because of a belief by Fluor Hanford personnel (as confirmed via interview) that the potential for system obstructions is very low based on water quality, continued satisfactory performance of system surveillances, and colloquial evidence that corrosion in the systems is not significant. The DOE Richland Office Fire Protection Engineer related alternative colloquial evidence, however, that would seem to offset the evidence of Fluor Hanford. As well, tuberculation of underground piping is demonstrated in the Hanford Site Water Supply Master Plan, providing potential sources for obstructive material for the fire protection systems. Also, experience by the Team members indicates that water trapped in dry systems can cause corrosion that leads to obstruction, as can objects that are not flushed from the underground water lines during installation or maintenance. These obstructions can affect fire suppression system performance, thus bringing into question conclusions from Fire Hazards Analyses, Authorization Basis documents, Exemption and Equivalency bases, and general fire protection practices.

Based on the interviews, there are conflicting ideas concerning the potential for obstructions in fire protection systems. NFPA 25 (1998), Section 10-2.2 indicates that:

*Systems shall be examined internally for obstructions where conditions exist that could cause obstructed piping. If the condition has not been corrected or the condition is one that could result in obstruction of piping despite any previous flushing procedures that have been performed, the system shall be examined internally for obstructions every 5 years. This investigation shall be accomplished by examining the interior of a dry valve or preaction valve and by removing two cross main flushing connections.*

Previous consideration by Fluor Hanford would indicate that there is a belief that conditions that could cause obstructed piping do not exist. Since that time, the fire protection community has experienced increased attention to microbiologically influenced corrosion (MIC) in piping and the idea that such corrosion could lead to obstructions in addition to means normally assumed. NFPA 25 (2002), Section 13.2.1 recognizes this condition, outright requiring internal inspections for corrosion and obstruction.

*An investigation of piping and branch line conditions shall be conducted every 5 years by opening a flushing connection at the end of one main and by removing a sprinkler toward the end of one branch line for the purpose of investigating for the presence of foreign organic and inorganic material.*

However, it is recognized that there is some apparent conflict between this requirement and NFPA 25 (2002), Section 13.2.3, which continues to state that “Systems shall be examined for internal obstructions where conditions exist that could cause obstructed piping.”

Given the conflicting colloquial evidence and the rising expectations for internal investigations by the fire protection community, there is a need to provide evidence, at the very least, that internal investigations are not needed. As such, compliance to the NFPA criteria would be met, and a defensible position can be provided by Fluor Hanford. A baseline study was indicated to be in the planning stages during this assessment, and would provide such information.

The second point of concern is pertinent to the underground water supplies for fire suppression systems. In the *Comprehensive Fire Safety Review* of Hanford, an issue particular to the Plutonium Finishing Plant regarding the integrity of the water supply prompted a Sitewide issue. During development of the Hanford Fire Department Needs Assessment, the Team performing that study noted that the last Sitewide water supply study was performed in 1995. While limited in scope, the analysis was comprehensive enough to base conclusions for prioritization of repairs and improving maintenance on the overall systems. The Needs Assessment Team did not identify a need to update the water supply analysis based on the conclusion that the Needs Assessment was primarily concerned with water supplies for firefighting responses, not system operation. Although fire protection system operation was considered a factor in baseline determinations, there was also an inherent assumption in the report that the evaluation was limited to a 5-7 year window, during which time a significant degradation of the water supply would not occur. The Needs Assessment Team also recognized the presence of a Water System Master Plan for the water supply system – noting that repair priorities and system corrections benefited fire response capabilities. However, the Needs Assessment Team did not examine the Water System Master Plan for consistency with overall fire protection issues.

Further review of the Water System Master Plan indicates that the potential for environmental issues was one of the major weighted factors used to prioritize underground water main replacement. While fire protection issues may have been considered in prioritizing repairs, it is not apparent from the document how much consideration was given. Interviews with Fire Protection Engineers with the HFD and with the Water Purveyor indicates that no significant input was requested for the Water System Master Plan, and that fire protection issues were not requested. The only point of reference provided within the document is an evaluation of fire

suppression water flow in Section 8.6, which appears to have minimal influence in the overall evaluation.

Based on this information, it is concluded that the Water System Master Plan does not address future fire water demands, priorities, and vulnerabilities for fire suppression systems that are important to safety. The Water System Master Plan does not appear to examine the water supply systems in light of fire protection systems that are considered important to safety or the future mission of those facilities.

During discussions regarding the Water System Master Plan, a concern was identified with the lack of rigor in control of fire water systems supplying internal fire protection systems. Interviews with Fire Protection Engineers, Fire Protection Systems personnel and Utilities managers indicates that informal relationships between Utilities and fire protection organizations exist. Additionally, the interviews revealed that a structured record keeping of water system valve closures that could lead to fire protection system impairments is not present. An example of this is a situation that occurred at the WRAP facility, as captured in Hanford Lessons Learned 2002-RL-HNF-0003. Due to a breakdown in controlling an underground valve, isolation of the WRAP facilities domestic and fire protection systems occurred without the knowledge of the Utility personnel. While a root cause as to why the underground valve was closed was not identified (at least to those interviewed), the possibility that the valve was closed by Utilities but not documented exists. Regardless of the cause, this provides a data point to validate the need for a more structured tracking system and interface with users of the water supply system. Such a system would reduce the potential for any breakdowns in the informal relationship between Utilities and users and would bring the largest portion of the Site's fire protection system into the more formalized program expected by the DOE Orders.

### **Supporting Objective FP.9.2**

*The Contractor has an inventory of fire protection systems within its facilities and has a schedule for performing inspection, testing, and maintenance of the fire protection systems.*

The HFD organizations hold a master list of active fire protection systems that are present in the various facilities. The list is amended as systems are installed or removed to ensure that inspection, testing, and maintenance items are performed as necessary. From the list, a master itinerary is developed each year to include all required items. From the lists, items pertinent to a specific system type, a particular facility, or a specified timeframe can be built.

This inventory list carries over to the individual facilities for those items that are the responsibility of the facility owners. With assistance from the HFD, the facilities enter the list of systems and the required tasks and performance times into their own tracking systems to ensure that the items are performed as required.

For the passive fire protection systems and life safety systems, the facilities have developed their own respective identification methods. In some facilities, such as Building 324, signs in the field identify emergency lights and exit signs, with the corresponding round sheets carrying the same identifiers for easy use. In other facilities, maps are attached to the round sheets to identify the location of equipment.

As indicated in Supporting Object FP9.1, the individual facilities have methods of scheduling and performing the inspection, testing, and maintenance of systems under their responsibility. See that section for more information.

### **Supporting Objective FP.9.3**

*The Contractor has a record of successfully completed inspection, testing, and maintenance of fire protection systems within Facilities or Areas for which the Contractor is contractually obligated.*

During the preparation of the Hanford Fire Department Needs Assessment, that Team reviewed completion records for systems, based on a need to ensure that system operability was being maintained so that utilizing credit for adequate fire protection in facilities could be justified. That review indicated that, for the items for which the HFD is responsible, successful completion could be demonstrated, with recognized exceptions. The exceptions were due, generally, to concerns that are considered within the realm of expected operations.

A review of round sheets, an examination of completion records for work packages, and interviews with facility personnel (including the Fire Protection Engineers) indicates that generally successful completion of inspection, testing, and maintenance is performed for those systems for which the facility manager is responsible. While a detailed review was not completed, there exists enough information to indicate a trend of attention and completion of the required items.

### **Supporting Objective FP.9.4**

*The Contractor has a method of identifying concerns generated during inspection, testing, and maintenance activities to facilitate immediate or near-term correction.*

HNF-RD-7899 is the primary reference for identifying concerns developed during the inspection, testing, and maintenance of fire protection and life safety systems, regardless of whether the activities are performed by the HFD or facility personnel. All personnel interviewed identified the procedure as the default methodology.

HNF-RD-7899 identifies, in Section 2.2, the requirements for System Restrictions and Impairments. Among the requirements is identification of the concern to facility management, and inclusion of the restriction or impairment in a deficiency tracking system, in accordance with HNF-PRO-052. Interviews indicated that facility management understood that the process applied to not only fire suppression or fire alarm systems, but to life safety systems and passive systems. A review of Deficiency Tracking System reports generated for the Assessment Team indicates that adequate implementation is occurring.

HNF-IP-939, Section 17.2 provides the steps required for the HFD groups to handle fire protection system impairments. This procedure applies specifically to the HFD organizations, and is not in general use throughout the Fluor Hanford program. Other processes, typically informal, are used for working through the impairment process, as outlined in HNF-RD-7899. Interviews with Operations Management and the Project Fire Protection Engineers indicate that the processes are varied, but their application meets minimum requirements of HNF-RD-7899.

## **Conclusion:**

Overall, the inspection, testing, and maintenance program for fire protection and life safety systems for Fluor Hanford is acceptable to conclude that the criteria, review and approach elements of this area were met. Fire protection systems are being professionally inspected, tested, and maintained in accordance with NFPA standards and DOE expectations and the HFD FST&M Organizations have qualified personnel to address the fire protection systems. In addition, Fluor facilities are inspecting and testing non-system fire protection features (e.g. fire doors, fire barriers, exit signs, etc.).

However, long-term planning and control of systems is a concern relative to fire protection water supplies. The Water Supply System Master Plan does not address long-term issues for fire protection. While the Master Plan addressed site wide water demands, it did not address specific needs for fire suppression systems that are important to safety. Furthermore, the Master Plan did not integrate fire protection systems needs and vulnerabilities in the weighted priority replacement matrix for underground piping consistent with facility missions and future needs of these important fire safety systems.

The Utilities group does not have structured programs to interface with fire protection system owners and facilities to ensure continued service of systems. Water supply component impairments supporting fire systems are not controlled with the same formality as internal fire protection systems.

Finally, an issue regarding obstruction investigations, raised as the result of lessons learned at the Idaho National Engineering and Environmental Laboratory, also questions the long-term capabilities of the systems.

## **Issues:**

1. Internal sprinkler piping obstruction investigations per NFPA 25 are not being performed. No baseline study is present to justify the lack of performance of the test.
2. The Water Supply System Master Plan does not address future fire water demands, priorities, and vulnerabilities for fire suppression systems that are important to safety.
3. There is not a structured or formal relationship between Utilities, the fire protection organizations, or the facilities regarding control of water supplies for fire protection. Water supply component impairments supporting fire systems are not controlled with the same formality as internal facility fire protection systems.

## **Administrative Controls and Compensatory Measures**

### **Objective FP.10 – Administrative Controls and Compensatory Measures**

The Contractor has a method of establishing, identifying, tracking, and maintaining administrative controls and compensatory measures.

**Supporting Objective FP.10.1.** Administrative controls and compensatory measures are adequately identified and meet the intent of the fire protection system or feature for which they are established.

**Supporting Objective FP.10.2.** The Contractor has a process for documenting administrative controls and compensatory measures.

**Supporting Objective FP.10.3.** The Contractor has a process for continued tracking of administrative controls and compensatory measures.

**Supporting Objective FP.10.4.** The Contractor has a process of maintaining administrative controls and compensatory measures.

#### **Criteria:**

1. Administrative controls and compensatory measures are adequately identified and justification is provided.
2. Facility and/or Area management are familiar with administrative controls and compensatory measures required for their area of responsibility.
3. Administrative controls and compensatory measures are documented in an implementation form (procedure, status board, Fire Protection Program document, etc.)
4. Administrative controls and compensatory measures are maintained current by the Contractor to ensure continued compliance and/or appropriate closure.

#### **Approach:**

1. Interview Facility or Area management, Fire Protection Program Management, and Fire Protection Engineering to determine what administrative controls or compensatory measures currently exist. Determine the basis for the administrative control or compensatory measure. Obtain the document from which the control or measure is based and review to ensure that adequate basis for the control or measure exists.
2. Obtain implementing documents or determine implementing methods for the administrative controls or compensatory measures. Implementing documents can be Facility or corporate based, depending on their scope. Facility based implementing measures should be compared between various facilities (the number and location to be determined by the team lead) to ensure consistent methods by the Contractor. Corporate based implementing documents should be compared to implementation at the facility level to ensure each Facility being assessed is cognizant and knowledgeable of the control or measure.

3. Verify that the implementation forms identified in Item 2 above are current compared to existing hazards and basis documents. Basis documents should have been identified in Item 1 above. Existing hazards for which the administrative controls or compensatory measures will need to be field verified.

**Basis:**

Administrative controls and compensatory measures usually address concerns of limiting fire conditions (generally via ignition control or combustible loading) or concerns of inadequate or out-of-service fire protection systems. Since both of these concerns are driven by the DOE fire protection related codes and standards, the impacts can be to life safety, worker safety, property protection, or protection of designated safety equipment. Therefore, administrative controls and compensatory measures require significant attention so that their intent and purpose are maintained.

**References:**

DOE O 420.1, Contract Requirements Document, Section 4.2.10.  
RLID 420.1, Section 8.12

**Interviews:**

As needed to determine compliance.

**Observations:**

None.

**PROCESS:**

**Records Reviewed:**

- DOE Orders and Documents:
  - DOE Order 420.1, *Facility Safety*, Chg. 3, Department of Energy, Washington D.C., November 22, 2000.
  - RLID 420.1, *RL Implementing Procedure for Fire Protection*, June 18, 1999.
  - Contractor Requirements Document (Supplemented) O420.1, Change 3 (Revision 0), *Facility Safety*, August 2001.
- Site Wide Documents:
  - HNF-RD-10606, Rev. 0, *Fire Protection Program Requirements*, April 29, 2002.
  - HNF-8663, Rev. 0, *Fluor Hanford Requirements Management Functional Area Document*, Section 12, *Fire Protection*, January 22, 2002.
  - HNF-RD-9390, Rev. 0, *Fire Hazards Analysis Requirements*, February 12, 2002.
  - HNF-RD-9391, Rev. 0, *Fire Protection Assessments*, March 28, 2002.
  - HNF-RD-8316, Rev. 0, *Safety Basis Requirements*, October 18, 2001.
  - HNF-RD-9717, Rev. 1, *Fire Prevention for Construction/Occupancy/Demolition Activities*, April 29, 2002.
  - HNF-RD-7899, Rev. 1, *Fire Protection System Testing/Inspection/Maintenance/Deficiencies*, April 11, 2002.
- Contractor Documents:

- EO-040-002, *Waste Encapsulation and Storage Facility (WESF) Perform General Surveillance*, Revision/Change G-7, May, 2002.
- EO-100-003, *Waste Encapsulation and Storage Facility (WESF) Perform Process Cell Transfers*, Revision/Change E-2, June, 2002.
- EO-020-001, *Waste Encapsulation and Storage Facility (WESF) WESF Hot Cell Combustible Material Inventory*, Revision/Change B-0, May, 2002.
- FP-4-014-002, *Spent Nuclear Fuel Project Fire Protection Program*, Rev 2, (Page Change B), May, 2001.
- HNF-IP-1264, *324/327 Facilities Stabilization Projects Administrative Manual*, Revision 3, March 2002.
- CP-24-001V, *Control of Combustible Materials Within CVDF*, Revision 0, Change A, July 2000.
- OP-06-002W, *Perform Routine Rounds at 105-KW*, Revision 14, May, 2002.
- OP-06-002W, *K West Round Sheet*, Revision 14, May, 2002.
- OP-06-001E, *Perform Routine Rounds at 105-KE*, Revision 8, May, 2002.
- OP-06-001E, *K East Round Sheet*, Revision 8, May, 2002.
- DO-040-016, *Treatment Facility Perform Weekly and Daily Surveillance of Waste Management Areas*, Revision/Change F-1, October, 2000.
- DO-040-004, *T Plant Operating Procedure, Perform Surveillance of Treatment Facility Emergency Equipment*, Revision/Change D-4, January, 2002.
- LO-040-101, *Analytical Services 222-S Complex Building Inspection*, Revision 2, May, 2002.
- Facility Rounds and Related Documentation:
  - A-6000-895.1, *Hotwork Permit*, JHA ID 1K-1911, Permit ID 1911-001, Work Request 1K-02-00012K, May, 2002.
  - OP-06-001E, *K East Round Sheet*, Revision 8, Completed for Rounds conducted on June 20, 2002.
  - LO-040-101, *Analytical Services 222-S Complex Building Inspection*, Completed for Rounds conducted June 26, 2002.
  - *Building 327 Hot Cell Combustible Loading Summary*, April 23, 2002.
  - LO-40-121, *Analytical Services Perform 222-S Surveillance*, April 15, 2002
  - LO-100-107, *Analytical Service Cubicle Housekeeping, Waste Disposal, and Management*. September 8, 2000
- Exemption Request Approval Letters (Note: DOE Richland Office Memoranda review also included original request documentation initiated by Contractor):
  - DOE Richland Office Memorandum 98-SFD-181, "Contract No. DE-AC06-96RL13200 – Section H-14, Laws, Regulations, And U.S. Department of Energy (DOE) Directives – Spent Nuclear Fuels Project's 100 K Area Exemption and Equivalency Requests", October 5, 1998.
  - DOE Richland Office Memorandum 02-SFO-0035, "Contract No. DE-AC06-96RL13200 – Request for Exemption Request For Area Separation Wall Requirements And Deviation Requirements For Automatic Sprinkler Protection In The 105 K-East/105 K-West Fuel Transfer System Annexes Project A15", March 20, 2002.
  - DOE Richland Office Memorandum 96-SFD-320, "Contract No. DE-AC06-96RL13200 – Project W-379, Spent Nuclear Fuel Canister Storage Building (CSB) Review and

Approval Of Exemption And Deviation Requests From Automatic Fire Sprinkler/Fire Suppression System Requirements”, December 18, 1996.

- DOE Richland Office Memorandum 00-SFO-110, “Contract No. DE-AC06-96RL13200 – Approval Of Finding Fire Hazards Analysis (FHA)-01 Equivalency Request For 105K-East (KE) and 105K-West (KW) Basins, May 23, 2000.
- DOE Richland Office Memorandum 00-SFO-143, “Contract No. DE-AC06-96RL13200 – Approval of Amendment For Finding FHA-01 Equivalency Request For The 105K-East (KE) and 105K-West (KW) Basins”, October 05, 2000.
- DOE Richland Office Memorandum 98-TPD-100, “Contract No. DE-AC06-96RL13200 – Exemption Request For The Requirement For An Automatic Sprinkler System For Rooms 334 And 335 In Building 234-5Z”, June 17, 1998.
- DOE Richland Office Memorandum 00-FTD-060, “Contract No. DE-AC06-96RL13200 – Approval Of 324 Building Fire Hazard Analysis And Associated Implementation Plan Resubmittal And Related Exemption And Equivalencies”, May 30, 2000.
- DOE Richland Office Memorandum 98-TPD-024, “Contract No. DE-AC06-96RL13200 – Section H-14, Laws, Regulations, And U.S. Department of Energy (DOE) Directives – Review Of Four Exemption Requests For Complete Automatic Sprinkler Suppression In The Waste Encapsulation Storage Facility (WESF) Fire Hazards Analysis”, February 11, 1998.
- Fluor Hanford, Inc. Memorandum FH-0201299, “T Plant Complex, Equivalency Request To RLID 420.1”, April 2, 2002.

**Personnel/ Positions Interviewed:**

Operations Supervisor

Fire Protection Engineer (Fire Marshal’s Office)

Fire Protection Engineer (Project)

Facility Representative

**Evolutions/Operations/Shift Performance Observed:**

All buildings were toured during normal activities.

**RESULTS:**

**Discussion of Results:**

DOE Order 420.1, Section 4.1.1.2 describes the general nuclear facility design requirements, including “the use of administrative controls which restrict deviations from normal operations and provide for recovery from accidents to provide a safe condition”. Section 4.2.1 (Item 2) of DOE Order 420.1 provides the requirements for a written fire prevention program, which would include administrative controls and combustible control procedures. Per Item 3, a system to ensure that the requirements of the DOE Fire Protection Program are documented and incorporated into the plans and specifications of new and existing facilities is required.

DOE Order 420.1 is implemented at the site level via RLID 420.1 [and CRD (supplemental) 420.1]. Section 6.2(i) requires a system to ensure that the requirements of the DOE Fire Protection Program are documented and incorporated into the plans and specifications of new and existing facilities, consistent with DOE Order 420.1, Section 4.2.1. Section 7.0 summarizes the general requirements for a combustible control/housekeeping program and calls for administrative procedures to control hazards in high risk facilities.

RLID 420.1 and CRD O420 are implemented at the contractor level through several requirements documents, such as HNF-RD-10606 and HNF-RD-9717, however there is no single requirement that addresses all issues in this CRAD. Other requirements documents may call for administrative controls (such as for hotwork) or controls may arise from the Authorization Basis (AB) (HNF-RD-8316) or Fire Hazards Analysis (HNF-RD-9390) documents. As well, administrative controls may stem from requirements enforced by the Fire Marshal through the permitting system or from self-assessment documents. At the facility level, administrative controls are addressed through a variety of procedures.

Compensatory measures, as opposed to administrative controls, are often implemented to address failures or intentional removal from service of fire protection or life safety systems. HNF-RD-7899 provides requirements for when compensatory measures must be put into place for both emergency and planned fire system impairments. Specifically, Section 2.2.3 of that document provides the minimum expectations for the type of compensatory measures that are expected.

There is no unifying requirement that administrative controls or compensatory measures be tracked and monitored in one central location. The DOE Orders cited above do, however, carry an expectation that they be properly implemented, continuously enforced, and periodically reviewed.

In evaluating this CRAD, the following facilities were reviewed:

- Buildings 105 KE and 105KW (K-Basins)
- Building 221-T (T-Plant)
- Building 222-S
- Building 225-B, WESF
- Building 242-A
- Building 324
- Building 327
- Canister Storage Building (CSB)
- Cold Vacuum Drying Facility (CVDF)

### **Supporting Objective FP.10.1**

*Administrative controls and compensatory measures are adequately identified and meet the intent of the fire protection system or feature for which they are established.*

This supporting objective is not met.

### **Programmatic Elements**

Based on the review of programmatic documents, the only element that includes specification of compensatory measures is fire system operability. HNF-RD-7899 requires the implementation of compensatory measures during fire system inoperability. Conversations with facility operations management revealed that building specific procedures or work control documents reference HNF-RD-7899 and thus indirectly include the requirement for compensatory measures.

Administrative controls can originate from any number of documents or processes. The Fire Hazards Analyses and Authorization Basis documents contain controls, both implicit and explicit. Derived from the FHA, in particular, are requirements to limit or exclude combustibles in various areas of the buildings. The same is true for the Authorization Basis documents. In general, there is a lack of attention to these controls and, in particular, to the implicit controls associated with assumptions made in the analyses.

As indicated in CRAD FP.6, Supporting Objective FP.6.4, there were several facilities that do not have a combustible control program in place (*viz.*, Building 222-S and Building 242-A). It was also noted that the combustible control programs in Buildings 324 and 327 focused on hot cells, and not general area protection. Also, Building 221-T (T-Plant) did not have combustible controls in place for the non-Canyon areas. Other examples, though not as obvious, are provided in the FHA documents.

In some instances, specific controls are not explicitly called out in the Fire Hazards Analysis. However, the fire modeling performed in the documents carries with them an implicit control that, if exceeded, invalidates the modeling for the FHA, and thus any conclusions drawn from the analysis regarding the relative safety of the facility. Examples include the following:

*Buildings 105KE/KW (K-Basins)*

- Miscellaneous transient combustible fuel packages evaluated in the FHA were 1-plywood crate and 1-bag of trash.
- Gearbox lubricant reservoir in the FHA is 27-gallons.
- Maximum quantity of diesel fuel evaluated in the FHA is 100-gallons.

*Building 222-A*

- Combustible liquids were not observed in the corridors
- 3.4 cubic meters of “Class A” combustibles were assumed on the 2<sup>nd</sup> floor.

*Building 242-A*

- Miscellaneous combustible material in the evaporator room are specific (boards) in the FHA.

The above combustible fuel packages were assumed in the FHA. In most cases, the fuel packages were found to be acceptable, and no recommendation was generated. However, there is no direct means of limiting the combustible fuel packages to those observed or assumed. Thus, the implicit control is not necessarily adhered to at the facility level. It should be noted that some facilities, such as Buildings 225-B and 324, have taken both the implicit and explicit controls from their FHA for implementation.

CRAD FP.6, Supporting Objective 6.5, Subsection B provides additional examples where administrative controls are implicitly credited in determining fires to have either low probability or low consequence. These controls are not directly specified and are not carried over into the administrative controls of the facilities.

Aside from the implications associated with failure to conform to authorization basis and FHA documents, the lack of overall combustible control spills over into the topic of Exemptions and

Equivalencies. Many of the existing Exemptions and Equivalencies reviewed use administrative controls and a low fire loss potential and consequence as a basis for their justification. In particular, the Exemptions and Equivalencies associated with Buildings 105KE, 105KW, 221-T, and 324 could be considered violated due to the lack of specific combustible controls. Although there does not appear to be a direct challenge to the conditions established in the FHA documents (see CRAD FP.6), the conditions that the Exemptions and Equivalencies are based on may not be continually met because of the lack of specific controls. Since these documents are tied directly to DOE Orders that are contractual obligations, there exists the possibility that a violation of the contract between Fluor Hanford and DOE Richland Office could occur if the controls established with the FHA are not followed with more detail and consistency.

There are lesser recognized locations from which administrative controls also flow. The Fire Marshal's Permit system, the Corrective Actions Management System (CAMS), and Facility Evaluation Board documents all identified administrative controls – either temporary or permanent – to address specific concerns.

#### *Explicit Facility Controls Required By AB And FHA Documents*

Explicit controls identified in the FHA and AB documents are generally implemented at the facilities via procedures and administrative controls. The controls typically are the result of specific recommendations or limits. Several procedures were reviewed and cross-referenced with the FHA and AB documents. Procedures and administrative controls for WESF, Building 324, Building 327, and T-Plant were reviewed and were found consistent with the FHA. Based on discussions with the facility personnel, when the FHA documents are modified, an Unresolved Safety Question is generated and the modifications are addressed in the AB if they are found to increase the accepted risk.

#### *Implementation Of FHA Controls In AB Documents*

Some improvements should be made to/or in the implementing controls from the fire hazards analysis (FHA) into the facility safety basis (SB):

- The Fire Protection Program for the 324 Building identifies (Section 5.2.6.7) several key elements that have not been carried over to the corresponding operational safety requirement (OSR) administrative controls (AC 5.4 and 5.5). Specifically, fire detection, fire suppression, fire department response, and staff training in fire protection were not identified as key program elements.
- Combustible loading limits identified by the 242-A Evaporator FHA (Section 6.4.1) have not been incorporated into the facility SB.

#### **Supporting Objective FP.10.2**

*The Contractor has a process for documenting administrative controls and compensatory measures.*

This supporting objective is not met because there is currently no required method to document administrative controls and compensatory measures.

The buildings that were used to compile this CRAD used a variety of facility-level procedures or processes to implement administrative controls, with varying degrees of success (See Supporting Object FP.10.1). Most procedures are developed from the Fire Hazards Analysis and Authorization Basis documents. There are other locations, however, from which administrative controls and compensatory measures arise, such as the Fire Marshal's Permit system and Exemption/Equivalency requests. These sources should be reviewed for implementation when documented.

Compensatory measures are typically documented in operations office locations (Shift Manager, Operations Manager, Stationary Operating Engineer Office, *etc.*) using status boards, log books, and other established means. Discussions with Shift Operations personnel indicate that the location and means used varies and is a function of the specific practices at the buildings. No issues were noted within the buildings toured.

### **Supporting Objective FP.10.3**

*The Contractor has a process for continued tracking of administrative controls and compensatory measures.*

This supporting objective is met.

Continued tracking of administrative controls contained in the facility level documents is accomplished through survey procedures. SOE or Operations rounds are the most commonly used form for implementing combustible controls that are specific to a facility. Particular application controls, such as those that apply to the truck entry into the Container Storage Building, are contained in operating procedures as a verification and validation step of the overall process. Failure to meet the objectives requires the implementation of the control within a specified time.

Compensatory measures are typically performed by the Shift Office or the SOE Office via standardized methods. Log book review, status board checks, shift turn-over, and work control within the facilities ensure that implemented compensatory measures are continued and appropriately closed upon completion of the return-to-service of the fire protection system.

These methods are typically integrated with other operations-required surveys and surveillances to limit the impact to Operations personnel. Based on a review of documentation provided by the facilities, it is concluded that administrative controls and compensatory measures are adequately tracked.

### **Supporting Objective FP.10.4**

*The Contractor has a process of maintaining administrative controls and compensatory measures.*

This supporting objective is not met.

Administrative controls are generally well maintained in practice, but not in the facility documentation. It was found that there are few actual conditions noted during the building

surveys that would, overall, challenge the Authorization Basis and FHA analyses. However, because of the lack of documentation of the required minimum conditions there is an a potential deficiency. The inability to coordinate administrative controls that are derived from any number of documents, tracking systems, or other processes presents a concern regarding conflicting administrative controls and a lack of overall knowledge of the implications of failure to adhere to the controls.

There is no centralized method for initiating, tracking, cross-referencing, and closing administrative controls at the facility level. With the number and implications of the administrative controls, a method should be developed, either formally or informally, to coordinate and track the various administrative controls that are implemented for fire protection. Such system should be able to track the origin of the controls and any implications associated with a failure to follow the controls.

Compensatory measures are required by HNF-RD-7899 and are implemented at the facility level in a number of ways, such as status boards, SOE logs, *etc.* They are standard methods that have been demonstrated to be an effective means of maintaining compensatory measures.

**Conclusion:**

The primary CRAD objective is not met because the facilities do not have a central means of tracking, initiating, cross-referencing, and closing administrative controls and compensatory measures. In addition, there are implicit (and to a lesser extent explicit) controls in the FHA and AB documents that are not implemented in any way. In some cases, Exemptions and Equivalencies are based on implied and/or explicit FHA controls. Because these controls are not always implemented at the facility level, there is a potential for Exemption and Equivalencies to be violated.

**Issues:**

1. There are implicit (and to a lesser extent explicit) controls also described in the FHA documents that are not implemented in the facility. In some cases, exemptions and equivalencies are based on implied and/or explicit FHA controls. Because these controls are not always implemented at the facility level, there is a potential for exemption and equivalencies to be violated. These controls may impact operational safety requirements for the facility and may impact fire safety equivalencies and exemptions. Implicit controls are directly related to the accident and fire scenario assumptions in the FHA and authorization basis documents and are difficult to capture. However, these assumptions may include the combustible load, configuration, facility makeup, and the ventilation conditions. This disconnect may arise because the FHA evaluations tend to focus on the most severe hazard that currently exists in a facility rather than attempting to determine the most severe condition that the facility can tolerate (*i.e.*, a limiting scenario).
2. Controls used as the basis for exemptions and equivalencies are not tracked and monitored. As a result, conditions may arise that invalidate a particular Exemption or Equivalency.
3. There is no centralized means of initiating, tracking, cross-referencing, and closing administrative controls at the building level and there is the potential for combustible and

fire conditions to exceed levels analyzed in the authorization basis and FHA documentation.

## **BIOGRAPHIES OF TEAM MEMBERS**

**Craig P. Christenson, P.E.**  
**U.S. Department of Energy**

**EDUCATION:**

Bachelor of Science - Fire Protection Engineering,  
University of Maryland, College Park, Maryland (May 1985)

**CERTIFICATION AND LICENSES:**

Registered Professional Engineer (P.E.): Fire Protection Engineering, CA State License No. FP-1186  
Fire Protection Engineering, WA State License No. 25863

**SUMMARY:**

A multidisciplinary principal fire protection engineer with over 15 years professional experience in the broad and comprehensive field of reducing consequences, loss of life and property impacts of fire by applied engineering fundamentals, research, FHA, design of fire protection systems for commercial buildings, industrial, and nuclear complexes and processes, research and development of fire propagation, detection and suppression, public and industrial fire department organizations, fire department incident command systems, emergency medical requirements, fire ground tactics, confined space requirements, and hazardous material responses.

**A partial list of experience includes:**

- Evaluation and recommendation concerning the content of Fire Protection Programs at Department of Energy (DOE) Hanford Nuclear Reservation. Provides direction to DOE and contractors to assure achievement of fire protection objectives and produce a level of fire protection, health, and safety performance, which is better than the national average.
- Design and engineering of fire protection systems for all types of commercial and industrial buildings, structures, and hazards for compliance with Department of Defense fire protection engineering criteria.
- Conducted fire protection surveys, inspections, and audits of large facilities and complexes of Marine Corps, Navy, Air Force, and Air National Guard shore facilities including field facility walk downs, facility water supplies, adequacy of fire department responses, fire prevention services, and fire system maintenance.
- Conducts FHA reviews, nuclear safety hazard analysis reviews, operational readiness reviews and field level inspections and assessments for complex industrial and nuclear facilities.
- Authored the DOE filter plenum fire protection criteria, which is included in the DOE Fire Protection Design Criteria Standard, DOE-STD-1066-99, March 1997.
- Team Leader for the development of the DOE Fire Protection Engineering Functional Area Qualification Standard, DOE-STD-1137-2000, July 2000.

**RELATED PROFESSIONAL MEMBERSHIP**

**Committee Member** - Department of Energy's National Fire Safety Committee.  
**Member** - National Fire Protection Association (NFPA), Quincy, Massachusetts.

**Guy E. Bishop, III**  
**U.S. Department of Energy**

**EDUCATION:**

Bachelor of Science - Aeronautical Engineering, Virginia Polytechnic Institute, Blacksburg, Va (1973)

**WORK EXPERIENCE:**

A multi-disciplinary general engineer with 27 years professional experience in military, civilian, and federal nuclear power operations. This includes: radioactive waste management and operation, core thermal hydraulics, accident analysis and modeling, hazards analysis, nuclear plant operations, code and regulation interpretation and compliance, standards development and implementation, power plant performance assessment, fire hazards analysis review, and safety analysis review and approval.

**Summary:**

- Naval nuclear power school. Engineering watch qualification on D1G and S3G cores. Naval nuclear power operations.
- Reactor engineer, core thermal hydraulics. Shift technical advisor, 560 mwe boiling water reactor.
- Power plant performance analysis. Wrote numerous computer programs to model and analyze plant thermal performance.
- Engineering design. Code and regulation compliance. Designed turbine building sprinkler system.
- NRC licensed Senior Reactor operator, 1150 mwe boiling water reactor. Nuclear power operations.
- Manager radioactive waste processing of large operating nuclear power plant.
- Development and implementation of numerous programs for Hanford single shell tank farms' safety and performance.
- Development of standards and requirements listing for Hanford tank farms.
- Review and approval of safety analysis for tank farms and spent nuclear fuel project at Hanford.
- Engineering design reviews for Hanford single shell tank farms and spent nuclear fuel project.
- Author of numerous papers presented at Energy Facility Contractors' Operating Group national conferences:
  - "Application of 'NRC Regulation Equivalency' to Construction of New DOE Nuclear Facilities";
  - "Removing Unreasonable Conservatisms in DOE Safety Analyses";
  - "Preparation of Phased and Merged Safety Analysis Reports for New DOE Nuclear Facilities";
  - "Hazards Classification of Environmental Restoration Sites at Hanford";
  - "Experiences in Decontamination and Demolition of a Former Plutonium Concentration Facility at the Hanford Reservation".

**CODES AND STANDARDS EXPERIENCE:**

DOE Orders and Procedures:

DOE 5480.21, "Unreviewed Safety Questions"  
DOE 5480.22, "Technical Safety Requirements"  
DOE 5480.23, "Nuclear Safety Analysis Reports"  
DOE 420.1, "Facility Safety"

DOE 6430.1A, "General Design Criteria"  
10 CFR 830, Subpart B.

Industry Codes:

ASME III

ASME VIII

ASME XI.

**Robert J. Wheeler, P.E.**  
**Hughes Associates, Inc.**

**EDUCATION:**

B.S., Fire Protection Engineering, University of Maryland, 1981

**EXPERIENCE SUMMARY:**

Corporate Affiliations:

- Hughes Associates Inc., 1995-present
- Science Applications International Corp., 1991-1995
- NUS Corporation, 1990-1991
- Westinghouse Savannah River Company, 1989-1990
- E.I. DuPont de Nemours & Co., Inc., 1987-1989
- Charles Gratz Fire Protection Co., Inc. 1986-1987
- Naval Facilities Engineering Command, 1982-1986

Areas of Specialization:

- Life Safety Analysis
- Fire Hazards/Risk Analysis
- Industrial/Special Hazards Analysis
- Fire Detection/Suppression Analysis

**PROFESSIONAL AFFILIATIONS:**

Licenses/Certifications/Memberships:

- Member, National Fire Protection Association
- Professional Engineer, Georgia
- Professional Engineer, North Carolina

**CODES AND STANDARDS EXPERIENCE:**

DOE Orders and Procedures:

- DOE O 420.1, Facility Safety
- DOE 5480.7A, Fire Protection
- DOE 5480.23, Nuclear Safety Analysis Reports
- DOE 6430.1A, General Design Criteria

Engineering Standards/Codes:

- NFPA 10, Portable Fire Extinguishers
- NFPA 12A, Halon 1301 Fire Extinguishing Systems
- NFPA 13, Sprinkler Systems
- NFPA 14, Standpipe Systems
- NFPA 20, Centrifugal Fire Pumps
- NFPA 22, Water Tanks
- NFPA 24, Fire Service Mains
- NFPA 30, Flammable and Combustible Liquids Code
- NFPA 72, National Fire Alarm Code
- NFPA 101, Life Safety Code
- Uniform Building Code
- Factory Mutual Data Sheets

**RELEVANT EXPERIENCE SUMMARY:**

At Hughes Associates, Inc. Mr. Wheeler is currently providing fire protection technical support to Westinghouse Savannah River Company (WSRC). Tasks include conducting design reviews, facility inspections, preparing equivalency and exemption requests, and conducting program and facility appraisals.

As a senior fire protection engineer with Science Applications International Corporation, Mr. Wheeler participated in the development of the fire hazards analyses for the Savannah River Site, K-Reactor, FB Line Facility, the Consolidated Tritium Facilities, and the Naval Fuel Facility. He has also served as the project manager for fire hazards analyses at DOE's Pinellas Plant and Buildings 45, T, and SW/R at the Mound Plant. He has participated as the lead fire protection engineer for Defense Program Technical Safety Appraisals of the Pantex Plant, Nevada Test Site, and Oak Ridge Y-12 Plant. He provided technical support to Sandia National Laboratories, Livermore, CA. Tasks included conducting design reviews, program and procedure development, and conducting facility appraisals of Buildings 910 and 913.

In addition to DOE facilities work, other work included performing numerous fire and safety surveys of Child Development Centers throughout the United States for the Naval Facilities Engineering Command. Items evaluated included fire suppression and detection systems, life safety, electrical safety, exposures, building construction, fire extinguishers, fire prevention, safety design, environmental and toxic hazard protection, and emergency procedures. He has also served as a guest lecturer on life safety at Texas A&M University.

As a fire protection engineer at NUS Corporation, Mr. Wheeler provided technical assistance to the Industrial Safety Branch of the Department of Energy Savannah River Operations Office. He participated in operational readiness reviews, performed design reviews of projects at various design stages to ensure compliance with DOE Orders and other applicable codes and standards, and conducted facility inspections and appraisals.

As a group manager with the Westinghouse Savannah River Company Mr. Wheeler directed the efforts of fire protection engineers responsible for the nuclear materials processing facilities at the Savannah River Site. The responsibilities of this group included the development of the WSRC fire protection policies and programs to meet DOE Orders, provide technical assistance to line organizations, and technical oversight of program implementation and effectiveness.

As a fire protection engineer at DuPont Mr. Wheeler provided technical assistance to all other DuPont departments at the Savannah River Site. He conducted design reviews, performed facility inspections and surveys, and witnessed system acceptance tests.

As a fire protection engineer at the Charles Gratz Fire Protection Company Mr. Wheeler was responsible for designing sprinkler systems and preparing cost estimates for installations.

As a fire protection engineer at the Northern Division, Naval Facilities Engineering Command Mr. Wheeler conducted fire protection surveys of existing Naval facilities, performed evaluations of proposed designs, applying Naval engineering standards and selected nationally recognized codes and technical standards, and witnessed final inspections and acceptance tests of fire protection systems.

**David V. Tomecek, P.E.**  
**Hughes Associates, Inc.**

**EDUCATION:**

B. S., Fire Protection Engineering, Summa Cum Laude, University of Maryland, 1992

**EXPERIENCE SUMMARY:**

Corporate Affiliations:

Hughes Associates Inc., 1997 - present  
Castlewood Fire Protection District, 1996 -1997  
Kaiser-Hill and EG&G Rocky Flats, 1993 - 1996  
Brinjac, Kambic, and Associates, 1992 - 1993  
University of Maryland, 1990 - 1992 (student)

Areas of Specialization:

Nuclear Fire Protection  
Fire System Design and Analysis  
Fire Hazards Analysis/Fire Protection Assessments  
Fire Protection Program Development  
Loss Control and Prevention  
Computer and Analytic Fire and Smoke Modeling  
Fire and Safety Audits  
Highly Protected Risk Assessments  
Special Hazards Protection and Mitigation  
Nuclear Ventilation Fire Protection

**PROFESSIONAL AFFILIATIONS:**

Licenses/Certifications/Memberships:

State of Colorado; Professional Engineer, #31760  
Member Society of Fire Protection Engineers  
Member National Fire Protection Association  
State of Colorado; Fire Suppression System Inspector  
State of Colorado; Fire Science Instructor Certificate  
International Fire Code Institute Fire Inspector Certification  
International Conference of Building Code Officials Plans Examiner Certification

**CODES AND STANDARDS EXPERIENCE:**

DOE Orders and Procedures:

DOE 5480.7A, Fire Protection  
DOE 6430.1A, General Design Criteria  
DOE O 420.1, Facility Safety  
DOE O 440.1, Worker Protection for DOE Federal and Contractor Employees  
DOE G 420.1/B-O, 440.1/E-O, Implementation Guide for DOE Orders 420.1 and 440.1

Engineering Standards/Codes:

NFPA 11, Installation of Low- and Medium-Expansion Foam Systems  
NFPA 11A, Installation of High-Expansion Foam Systems

NFPA 12, Carbon Dioxide Extinguishing Systems  
NFPA 12A, Halon 1301 Extinguishing Systems  
NFPA 13, Installation of Sprinkler Systems  
NFPA 14, Standpipes  
NFPA 15, Installation of Water Spray Systems  
NFPA 17, Installation of Dry Chemical Systems  
NFPA 17A, Installation of Wet Chemical Systems  
NFPA 20, Installation of Centrifugal Fire Pumps  
NFPA 24, Installation of Private Fire Mains and Their Appurtenances  
NFPA 72, National Fire Alarm Code  
NFPA 101, Safety to Life from Fire in Buildings and Structures  
NFPA 2001, Installation of Clean Agent Fire Suppression Systems  
IRI Information Data Sheets  
Factory Mutual Loss Prevention Data Sheets  
Uniform Building Code  
Uniform Fire Code  
National Building Code  
National Fire Code  
Standard Building Code  
Standard Fire Code

#### **RELEVANT EXPERIENCE SUMMARY:**

With Hughes Associates, Inc., Mr. Tomecek is a staff engineer providing engineering and technical services to a variety of clients. Fire system design, plan review, code conformance studies, and technical assessments form part of the work performed. In addition, oversight of other staff engineers and mentoring of personnel is part of Mr. Tomecek's duties.

As part of the Fire Protection Engineering team at Rocky Flats, Mr. Tomecek acts as the lead engineer, coordinating the fire protection engineering services for the site. Reporting directly to the Manager of Fire Protection Engineering, his duties include not only technical support, but input to policy and standard methodologies for performing analyses. Previous employment with Kaiser-Hill and EG&G Rocky Flats are also part of Mr. Tomecek's experience at Rocky Flats. Duties over his time of experience include engineering design reviews; code interpretation and evaluation; fire protection system calculations; fire protection systems modification evaluations and designs; fire protection and safety evaluations and analyses; computer and analytic fire and smoke modeling; and support of other engineering disciplines. Administrative duties include document and report preparation.

During the period between 1996 through 1997, Mr. Tomecek was employed by the Castlewood Fire Protection District as the Fire Protection Engineer for the district. Although part of the Fire Prevention Bureau, Mr. Tomecek duties included Fire Investigation, Hazardous Materials, Public Education, Training, and Operations Divisions. Engineering duties included engineering design reviews; code interpretation and evaluation; site planning evaluations; fire protection and life safety evaluations and analyses; assessments of computer and analytic fire and smoke modeling, and support of other department functions. Engineering techniques were applied to Fire Investigations and Hazardous Materials responses. Interaction with public utility managers and local governmental authorities provided involvement with policy development related to fire protection in those arenas.

As a staff engineer Brinjac, Kambic, and Associates, Mr. Tomecek was part of a team that was responsible primarily for the design of fire suppression systems for new structures. Design of smoke control systems, fire detection and alarm systems, and other specialty systems were also undertaken. Life safety analyses and hazard assessments were performed as requested by clients and local authorities.

Engineering duties included preliminary design of fire suppression systems; shop drawing and product data review; computer and analytic fire and smoke modeling; product data research; hydraulic calculations; and code evaluation.

As a student research assistant at the University of Maryland's Department of Fire Protection Engineering. Initial research involved the response of composites under structural load and exposed to fire. Construction and testing of composites, computer modeling of thermal and mechanical responses, and use of spreadsheets and CAD programs make up the bulk of the work performed. A second project involved the verification of a computer smoke and fire model, which included data acquisition and compilation, model validation, and report composition.

Prior to employment with Hughes Associates, Inc., Mr. Tomecek performed independent consulting and engineering. Services included automatic sprinkler design, fire suppression system evaluations, studies involving heat transfer through structural assemblies, and code analyses. One project included work with various computer fire models and fire protection theory to create and present a 40 hour class on interpreting computer fire models and their output for the Fire Marshals Association of North America (NFPA/FMANA).

**Sean P. Hunt, P.E.**  
**Hughes Associates, Inc.**

**EDUCATION:**

B.S., Civil Engineering, Worcester Polytechnic Institute, 1990  
M.S. Fire Protection Engineering, Worcester Polytechnic Institute, 1992

**EXPERIENCE SUMMARY:**

Corporate Affiliations:

Hughes Associates, 1992-present  
Worcester Polytechnic Institute, 1990-1992  
Riley Stoker Consolidated, Worcester, MA, 1988-1990

Areas of Specialization:

Computer Fire Modeling  
Fire Hazard Assessment  
Fire Detection/Suppression Analyses

**PROFESSIONAL AFFILIATIONS:**

Licenses/Certifications/Memberships:

Society of Fire Protection Engineers  
National Fire Protection Association  
American Society of Civil Engineers (ASCE)  
Salamander Honorary Society  
Professional Engineer, Maryland  
Committee on Special Design Considerations, ASCE

**CODES AND STANDARDS EXPERIENCE:**

DOE Orders and Procedures:

DOE O 420.1, Facility Safety  
DOE 5480.7A, Fire Protection  
DOE 6430.1A, General Design Criteria

Engineering Standards/Codes:

NFPA 101, Life Safety Code  
NFPA 13, 13R, Sprinkler Standards  
NFPA 12A, 12B, Halon Extinguishing Systems  
ASTM C177, Thermal Transmission Properties  
Factory Mutual Data Sheets

**RELEVANT EXPERIENCE SUMMARY:**

At Hughes Associates, Inc., Mr. Hunt has worked on a number of technical fire protection problems for government and private organizations. He has assisted in numerous fire hazard assessments and safety evaluations reports for DOE facilities. His focus is primarily on develop fire scenarios and predict the impact of these scenarios on the potential for contamination release. Facilities with which Mr. Hunt has worked include evaporators, nuclear power plants, plutonium finishing plants, waste encapsulation facilities, waste drum storage, warehouse facilities, tank farms, and radiochemical processing laboratories. Besides fire hazard assessments and safety evaluations, Mr. Hunt has been involved with several technical

issues including fuel loading analyses and greenhouse fire hazards. Most analyses require extensive computer modeling, including zone fire models, heat transfer software, and computational fluid dynamics programs.

Other recent work includes two-dimensional flame spread along vertical surfaces, statistical evaluation of the impact of fire department response time on the level of damage to a structure, prediction of discharge time and mass flow for halon replacements in pipe networks, hazard analysis of large plastic signs in public locations, calculation of contamination release from smoke stacks, smoke movement in large spaces such as airports and arenas, and explosion analyses of sludge facilities development of a computerized Life Safety Code and Smoke Movement Studies.

As a graduate student at Worcester Polytechnic Institute, Mr. Hunt was involved in the experimental and theoretical analyses of the thermal and structural response of ship bulkhead material.